Issued January 1970

SOIL SURVEY
Lincoln County, Oklahoma

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
in cooperation with
OKLAHOMA AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey was done in the period 1957–65. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1966. This survey was made cooperatively by the *Soil Conservation Service* and the Oklahoma Agricultural Experiment Station; it is part of the technical assistance furnished to the Lincoln County Soil and Water Conservation District.

Either enlarged or reduced copies of the printed soil map can be made by commercial photographers, or can be purchased, on individual order, from the Cartographic Division, Soil Conservation Service, USDA, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Lincoln County contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, or other structures; and in judging the suitability of tracts of land for agriculture, industry, or recreation.

Locating Soils

All of the soils of Lincoln County are shown on the detailed map at the back of this survey. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by a symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the survey. This guide lists all of the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the range site, woodland suitability group, or any other group in which the soil has been placed. It also lists the capability unit for each mapping unit.

Interpretations not included in the text can be developed by using the soil map and information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils in the soil descriptions and in the discussions of range sites and of woodland suitability groups.

Those who are interested in woodland can refer to the section "Management of Soils for Windbreaks and Post Lots," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others concerned with wildlife will find information about soils and wildlife in the section "Use of Soils for Wildlife."

Ranchers and others interested in range can find, under "Use of Soils for Range," groupings of the soils according to their suitability for range, and also the plants that grow on each range site.

Engineers and builders will find under "Use of Soils in Engineering" tables that give engineering descriptions of the soils in the county and that name soil features that affect engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Formation and Classification of Soils."

Newcomers in Lincoln County may be especially interested in the section "General Soil Map," where broad patterns of soils are described.

***Cover picture.*—Small grain pasture on Port soils.**

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Contents

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SOIL SURVEY OF LINCOLN COUNTY, OKLAHOMA

BY GLEN E. WILLIAMS AND DONALD G. BARTOLINA, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE OKLAHOMA AGRICULTURAL EXPERIMENT STATION

LINCOLN COUNTY is in the central part of Oklahoma. Distances by air from Chandler, the county seat, to principal cities in the State are shown in figure 1.

The area of the county is 622,720 acres or about 973 square miles. About 17 percent of the county is bottom land, 39 percent is upland prairie, and 44 percent is partly wooded land in the Cross Timbers area. The Deep Fork North Candian River crosses the county from west to east, and the North Canadian River flows through a small part of the southwestern corner of Lincoln County.

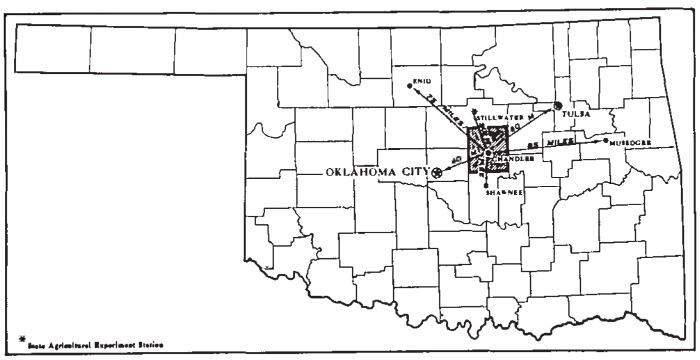

Figure 1.—Location of Lincoln County in Oklahoma.

Lincoln County was formed from the lands of the Sac and Fox and Iowa Indian Reservations, which were opened to white settlers in 1891. When the Kickapoo Indian Reservation was opened to settlement in 1895, a large part of it was added to the southwestern part of Lincoln County. The 1960 Census showed the population of Lincoln County to be 18,783.

The area is dominantly agricultural, and raising livestock is the main enterprise. Small grains, alfalfa, and grain sorghum are commonly grown.

The present trend in the county is to larger farms and ranches. Recent data indicate an increase in the number of farms or ranches larger than 500 acres and a decrease in those smaller than 500 acres. The acreage of alfalfa has increased during the past several years. The acreage of peanuts has decreased because of allotments, but the yield per acre has increased sharply. Other crops have decreased in acreage. Cotton, once a key cash crop, and other cultivated crops are not grown extensively. Much formerly cultivated land has been planted to tame pasture or is used as range. The trend of converting cropland to tame pasture continues. In recent years the clearing of timbered land for tame pasture or native range has been extensive. This trend is increasing.

Climate of Lincoln County[1]

Lincoln County is about 40 miles northeast of the center of Oklahoma. The moderately rolling landscape ranges from about 800 to 1,150 feet above mean sea level. The county has a warm-temperate continental climate. Storms are significant when the warm, moisture-laden air comes in from the Gulf of Mexico and is met by the cool, drier air from the Pacific and Arctic regions. Table 1 summarizes the records of temperature and precipitation at Chandler.

Daily and seasonal changes in temperature are pronounced in Lincoln County. Although gradual, variations in seasonal and annual precipitation are considerable. The weather varies more in spring than in other seasons. Severe local storms are most frequent in spring, and precipitation is greatest. Although some replanting may be necessary because of the heavy rains, moisture is generally adequate in spring for initial growth of crops, and also for supplying reserves in the subsoil for later use during drier months in summer when crops are maturing.

Summer is long and usually hot. The hottest spells frequently are eased by cool nights, refreshing breeze, and a few showers and thunderstorms. Fall is mild and has long sunny periods and only a few days of moderately soaking rains. Winter is generally sunny, but there are brief periods of rather low temperature when snow may cover the ground for a few days. Long periods of intense cold are not common, because the moderating southerly winds usually return after a few days' absence.

Climate records at Chandler show a mean annual temperature of 61.4° F. Monthly averages range from about 39° in January to 83° in August. The average daily range in temperature is 24°. From March through October, temperature has risen to 90° or above on an average of 83 days per year. A temperature of 100° or above can be expected on an average of 21 days from June through September. The greatest number of such hot days was 77

[1] By STANLEY G. HOLBROOK, State climatologist, U.S. Weather Bureau.

in 1936, when 18 days were consecutive in July and 27 days were consecutive in August. The average hottest day in a year is 106°, and in only 1 year out of 4 does the temperature rise to 110° or above.

An accumulative measure of cool weather at Chandler shows an annual total of 3,373 mean degree-days. Annual degree-days are computed by recording, for each day, the number of degrees that the mean daily temperature is below 65° and by totaling these amounts. The degree-days are 10 for a day when the mean daily temperature is 55°. The mean degree-days average from zero in June through August to a maximum of 806 in January. Freezing temperatures occur from October through April on an average of 84 days per year, with daily highs failing to rise above the freezing mark on only 7 of these days. In about half of the years, the temperature is zero or below for about 1 day during the year.

Table 2 gives probabilities, by specified dates, for last freezing temperatures in spring and first freezing temperatures in fall. These dates vary a few days throughout the county, depending on elevation, surface drainage of cold air, and the condition of the ground. In a local area over a long period, the variation in dates is greater. Across Lincoln County the average freeze-free period ranges from 205 days in the west-central part to 215 days in the northeastern part.

TABLE 1.—*Temperature and precipitation*

[Data from Chandler in period 1931–60]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with— Maximum temperature equal to or higher than—	Two years in 10 will have at least 4 days with— Minimum temperature equal to or lower than—	Average monthly total	One year in 10 will have— Monthly total less than—	One year in 10 will have— Monthly total more than—	Days with snow cover 1 inch or more	Average depth of snow on days with snow cover
	° F.	° F.	° F.	° F.	Inches	Inches	Inches	Number	Inches
January	50.4	27.5	68	8	1.58	0.1	4.0	3	2
February	54.9	31.4	73	15	1.70	.6	2.9	1	2
March	63.4	37.7	82	19	2.21	.4	4.8	1	3
April	73.7	49.1	87	35	3.62	.8	8.7	0	0
May	80.1	57.6	90	44	5.14	1.6	10.2	0	0
June	89.2	66.8	100	56	4.51	.7	10.2	0	0
July	94.5	70.4	103	62	3.16	.6	6.0	0	0
August	95.3	69.9	107	60	2.68	.6	4.1	0	0
September	88.1	61.7	101	47	3.46	.5	8.7	0	0
October	77.2	50.9	91	35	2.77	.4	4.3	0	0
November	62.8	37.4	79	23	2.11	.1	4.5	(1)	2
December	53.2	30.5	70	15	1.50	.1	3.0	1	3
Year	73.6	49.2	[2] 106	[3] 2	34.44	26.1	43.8	6	2

[1] Less than 0.5 day. [2] Average annual highest maximum. [3] Average annual lowest minimum.

TABLE 2.—*Probabilities of last freezing temperatures in spring and first in fall*

[Data from Chandler in period 1921–50]

Probability	Dates for given probability and temperature				
	16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10 later than	March 10	March 25	April 2	April 8	April 16
2 years in 10 later than	March 2	March 18	March 27	April 3	April 11
5 years in 10 later than	February 15	March 5	March 15	March 25	April 1
Fall:					
1 year in 10 earlier than	November 29	November 17	November 4	October 23	October 13
2 years in 10 earlier than	December 6	November 24	November 11	October 30	October 18
5 years in 10 earlier than	December 18	December 5	November 24	November 11	October 29

The mean annual precipitation ranges from about 33 inches in the west-central part of the county to about 37 inches in the northeastern part. Rainfall of less than 20 inches or of more than 50 inches occurs in 1 year out of 15. The seasonal distribution is 32 percent in spring, 30 percent in summer, 24 percent in fall, and 14 percent in winter. Drier months that have less than 0.50 inches in rainfall occur in 2 years out of 3 and are most common during August and from November through March. Daily rains of 3 to 6 inches occur in 1 year out of 3 and are most frequent in June. Daily totals of 0.1 inch or more occur on an average of 55 days per year; of 0.5 inch or more, on 23 days; and of 1.0 inch or more, on 10 days.

Seasonal snowfall averages from 5.5 inches in the southeastern corner of the county to 7.5 inches in the northwestern part. The annual average for Chandler is 6.5 inches, but in 1 year out of 10 there is only a trace. In the winter of 1947–48 a record total of 20 inches fell at Chandler. The heaviest snows usually melt within a few days.

Because records on wind, sunshine, relative humidity, and evaporation are not kept in Lincoln County, the following estimates were interpolated from the records at Oklahoma City and other stations nearby. Windspeed averages about 13 miles per hour, and ranges from 11 miles per hour in August to 15 miles per hour in March and April. Southerly and southeasterly winds prevail, except during January and February when prevailing winds are northerly.

Skies are clear during the day for 140 days per year. During summer relative humidity averages from about 85 percent at 6 a.m. to about 50 percent at 6 p.m. During the winter the average is from about 80 percent at 6 a. m. to about 62 percent at 6 p.m. Annual lake evaporation averages 58 inches per year, and about 70 percent of this amount evaporates from May through October.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Lincoln County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and the soil phase are the categories of soil classification most used in local surveys.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Chickasha and Dale, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the undisturbed landscape.

Soils of one series can differ in textures of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Vanoss loam, 1 to 3 percent slopes, is one of several phases within the Vanoss series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show buildings, field borders, trees, and other details that greatly help in drawing boundaries accurately. The soil map at the back of this survey was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Lincoln County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two kinds of soils so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two more dominant soils, and the pattern and relative proportion are about the same in all areas. The name of the soil complex consists of the names of the dominant soils joined by a hyphen. Darnell-Stephenville complex, 3 to 12 percent slopes, severely eroded, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is no value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. If there are two or more dominant series represented in the group, the name of the group consists of the name of the dominant soils joined by "and". Chickasha and Bonham soils, 2 to 6 percent slopes, severely eroded, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the map and are described in the survey, but are called land types instead of soils and are given descriptive names. Broken alluvial land and Wet alluvial land are land types in Lincoln County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data on the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils used for crops and pasture.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, and engineers.

On the basis of the yield tables and other data, the soil scientists set up trial groups and test them by further study and by consultation with farmers, agronomists, engineers, and others. Then the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Lincoln County, Oklahoma. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The four soil associations in Lincoln County are described briefly in this section. More detailed information about the individual soils in each association can be obtained from the detailed soil map and from the section "Descriptions of the Soils."

1. Port-Pulaski Association

Deep, level and nearly level, loamy soils on flood plains

This association consists of soils on flood plains and terraces along rivers and smaller streams throughout the county (fig. 2). Areas of these soils are widely scattered. This association occupies 103,884 acres, or about 17 percent of the county.

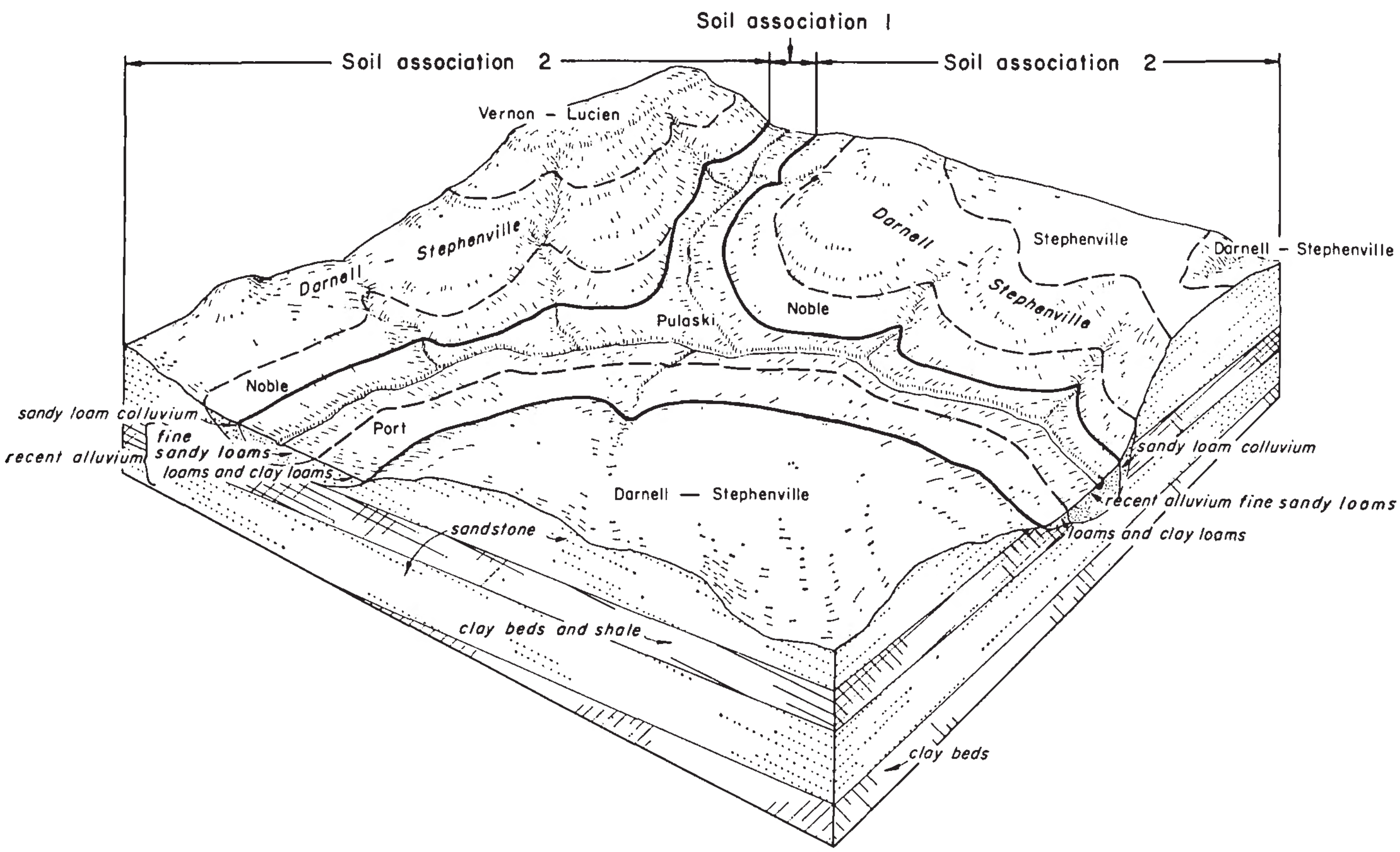

Figure 2.—**Typical pattern of soils in associations 1 and 2.**

The Port soils make up about 30 percent of the association; the Pulaski soils, about 30 percent; Broken alluvial land and water, about 22 percent; and minor soils, the remaining 18 percent. The alluvial land is in broken areas and wet areas.

Port soils are dominantly well drained, though flooding is occasional to frequent. They have a loam or clay loam surface layer, typically about 13 inches thick, that is underlain by weak strata of loam to clay loam.

Pulaski soils are well drained and poorly drained. They are occasionally flooded by streams, and in some areas water from springs or clogged channels generally is on or within 2 feet of the surface. Pulaski soils have a fine sandy loam surface layer, typically about 16 inches thick. It is underlain by fine sandy loam that is stratified with loamy fine sand at depths below 36 inches.

Among the minor soils in this association are the Mason, Miller, Roebuck, and Yahola. All of these soils are on bottom lands. The Miller soils are generally flooded about three times a year, but Mason soils are seldom flooded. Roebuck soils are poorly drained and are frequently flooded. Flooding is occasional to frequent on the Yahola soils.

Crops grow well in most areas of this association, but not in those that are excessively wet. Most areas are used for alfalfa and small grains. Also suitable are improved pasture and native-grass range.

2. Darnell-Stephenville Association

Very gently sloping to strongly sloping, loamy soils, very shallow to deep over sandstone, on forested uplands

This association consists of soils on narrow ridgetops, on sharply breaking slopes, and in colluvial-alluvial valleys (see fig. 2). These soils developed from red, acid, weathered sandstone in wooded uplands. This association occupies about 236,984 acres, or 38 percent of the county.

The Darnell soils make up about 50 percent of this association; Stephenville soils, about 35 percent; and minor soils, the remaining 15 percent.

The Darnell soils are somewhat excessively drained. They have a fine sandy loam surface layer and a loamy fine sand subsoil. The subsoil grades to sandstone, typically at a depth of about 14 inches.

The Stephenville soils are well drained. They have a fine sandy loam surface layer that typically is about 14 inches thick and is underlain by a sandy clay loam subsoil. Sandstone generally is at a depth of about 31 inches.

Minor soils are in the Noble, Zaneis, Chickasha, Lucien, Vernon, Renfrow, and Pulaski series. Noble soils are deep and occur in narrow colluvial areas below areas of closely intermingled Darnell and Stephenville soils. Zaneis, Chickasha, Lucien, Vernon, and Renfrow soils occupy small prairie openings in wooded areas. Pulaski soils occupy drainageways and flood plains of small streams.

Most of this association is used for grazing, but peanuts, small grains, and grain sorghum are grown in some areas of Stephenville and Noble soils. The growth of grasses is poor because trees compete for the available moisture. Small openings among the trees provide most of the good grazing. Grasses grow well where brush and trees are controlled by spraying with herbicides and by clearing with a bulldozer. After trees are cleared, however, oaks may sprout from living roots. Careful management of grazing is needed in cleared areas to keep grasses growing vigorously. Many areas have been poorly managed and are severely eroded.

3. Renfrow-Vernon-Bonham Association

Very gently sloping to moderately steep, loamy soils, deep to shallow over clay or shale, on prairie uplands

This association consists of very gently sloping to moderately steep soils that occur throughout the county on prairie uplands (fig. 3). It occupies 244,846 acres, or about 39 percent of the county.

The Renfrow soils make up 25 percent of this association; Vernon soils, about 25 percent; Bonham soils, about 20 percent; and minor soils, the remaining 30 percent.

The Renfrow soils are deep and well drained. They have a silt loam surface layer, typically about 9 inches thick, that grades to a very slowly permeable clay subsoil.

The Vernon soils are shallow over shale and clay, are calcareous, and are somewhat excessively drained. Their surface layer is clay loam, typically about 5 inches thick. It is underlain by a clay subsoil.

The Bonham soils are deep and well drained and have uniform slopes. They have a loam surface layer that is about 12 inches thick over a slowly permeable subsoil.

Minor soils are in the Chickasha, Zaneis, Kirkland, Collinsville, Lucien, Port, Pulaski, and Yahola series. Chickasha and Zaneis soils are deep to moderately deep, loamy soils that formed from weathered sandstone. Kirkland soils have a loamy surface layer and occur in small areas on stream divides. Collinsville and Lucien soils are shallow to very shallow and are gently sloping to moderately steep. Port, Pulaski, and Yahola soils occur in small areas on the bottom lands.

The deep soils in this association are moderate to high in natural fertility and are suitable for cultivation. Small grains and grain sorghum are the main crops. These crops and native pasture plants grow moderately well if management is good. The shallow and very shallow soils are well suited to range and are moderately well suited to pasture, but they are not suited to cultivated crops. In many areas the soils in this association have been poorly managed and are severely eroded.

4. Konawa-Dougherty-Teller Association

Deep, nearly level to strongly sloping, sandy to loamy soils on uplands

This association consists of soils on high terraces, mainly along the Deep Fork North Canadian River and some of the larger creeks in the county, and also near the North Canadian River. These soils developed in sandy and loamy Pleistocene sediments under a cover of blackjack and post oaks and tall grasses. This association occupies 37,657 acres, or about 6 percent of the county.

The Konawa soils make up about 30 percent of this association; Dougherty soils, about 25 percent; Teller soils, about 15 percent; and minor soils, the remaining 30 percent.

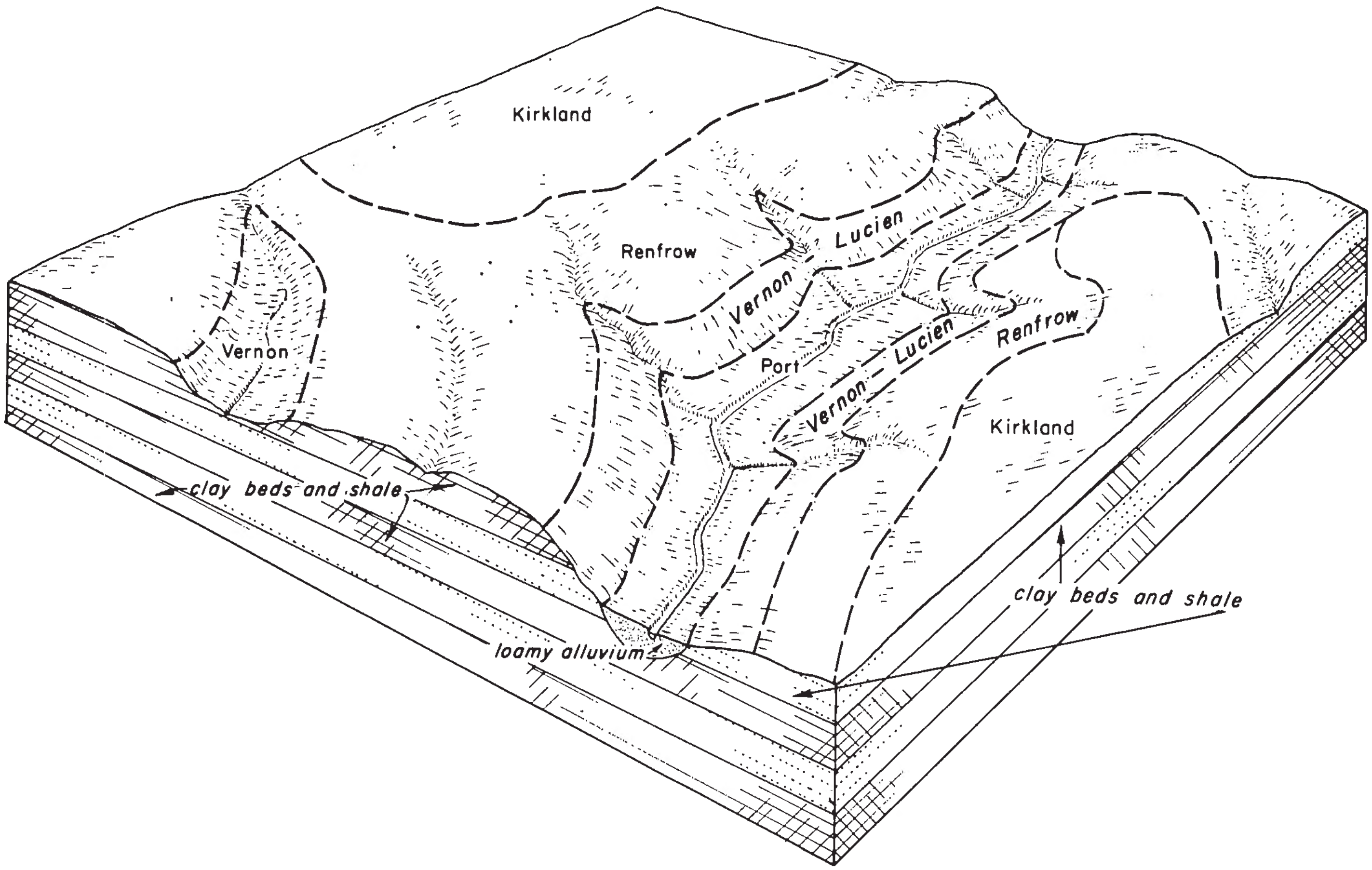

Figure 3.—**Typical pattern of soils in association 3.**

In many places the Konawa soils are less sloping than the soils in most parts of this association, but in about half of their acreage Konawa soils are gently sloping to sloping and are severely eroded. These soils are well drained. Typically they have a loamy fine sand surface layer that is about 14 inches thick and is underlain by a sandy clay loam subsoil.

Dougherty soils also are well drained. They are gently sloping to strongly sloping but generally are not more than slightly eroded. Dougherty soils have a loamy fine sand surface layer. It is about 26 inches thick and is underlain by a sandy clay loam and fine sandy loam subsoil.

Teller soils are very gently sloping to gently sloping and are well drained to somewhat excessively drained. They have a loam surface layer, typically about 10 inches thick. It is underlain by a loam and clay loam subsoil that grades to loam underlying material.

Minor soils are in the Eufaula, Vanoss, and Norge series. Eufaula soils are closely intermingled with the Dougherty soils but have a thicker loamy fine sand surface layer. Norge and Vanoss soils are well drained. In the uplands, they are the better suited soils for farming.

About one-third of the acreage of Konawa soils and a small part of the smoother areas of Dougherty soils are cropped to small grains and grain sorghum. The rest of this association is used for native range and tame pasture. Konawa and Dougherty soils are low in natural fertility and are subject to severe soil blowing and gullying. The Teller, Vanoss, and Norge soils have moderate to high fertility and, if management is good, are well suited to cultivated crops, improved pasture, or native grasses. Water erosion is a hazard if these soils are not managed well.

Descriptions of the Soils

This section describes the soil series and mapping units in Lincoln County. The acreage and proportionate extent of each mapping unit are shown in table 3.

The procedure is first to describe each soil series, and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the series to which it belongs.

The soil series contains a brief nontechnical description of a soil profile, the major layers from the surface downward. This profile is considered typical for all the soils of the series. If the profile for a given mapping unit differs from this typical profile, the differences are stated in the description of the mapping unit, unless the differences are apparent in the name of the mapping unit. Also

described for the series is a detailed technical profile typical for the series. This profile is included for soil scientists, engineers, and others who need to make thorough and precise studies of the soils.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Broken alluvial land, for example, does not belong to a soil series, but nevertheless is listed in alphabetic order along with the soil series.

Not all soil boundaries on the Lincoln County soil map join with those on maps of Creek and Logan Counties that were surveyed and published earlier. Part of the differences result from refinement in the current system of soil classification and part from greater detail required for present needs in use and management.

The description of each mapping unit suitable for cultivation contains suggestions on how the mapping unit can be managed. Management of soils under native grasses, however, is discussed in the section "Use of Soils for Range." Suitability of the soils for trees and shrubs used in windbreaks and for post lots is given in the section, "Management of Soils for Windbreaks and Post Lots." Behavior of the soils when used as sites for structures or as material for construction is discussed in the section "Use of Soils in Engineering." The section "Use of Soils for Wildlife" tells how soils can be managed to improve the wildlife in the county.

Bonham Series

Soils of the Bonham series are on the prairie and are deep, dark, and loamy. They are moderately extensive in the eastern one-third of the county. The largest areas are near Stroud. These soils have convex slopes and are gently sloping to very gently sloping. They developed in material weathered from clayey shale under tall grasses.

In a typical profile the surface layer is slightly acid, dark grayish-brown loam about 12 inches thick. The subsoil extends to a depth of 66 inches or more. Its upper 8 inches is dark-brown loam. Below this, to a depth of 52 inches, the subsoil is brown to yellowish-brown silty clay loam. Between depths of 20 and 44 inches, it is mottled with dark reddish brown to yellowish red. At a depth of about 52 inches the subsoil is calcareous.

Bonham soils are well drained to moderately well drained and are moderately fertile. They are slowly permeable and have moderate to high water-holding capacity.

TABLE 3.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Bonham loam, 1 to 3 percent slopes	5,690	0.9
Bonham loam, 3 to 5 percent slopes	6,450	1.0
Bonham loam, 2 to 5 percent slopes, eroded	12,310	2.0
Breaks-Alluvial land complex	16,475	2.6
Broken alluvial land	7,175	1.2
Chickasha loam, 1 to 3 percent slopes	4,705	.8
Chickasha loam, 3 to 5 percent slopes	5,695	.9
Chickasha loam, 2 to 5 percent slopes, eroded	12,985	2.1
Chickasha and Bonham soils, 2 to 6 percent slopes, severely eroded	47,730	7.7
Crevasse loamy fine sand	195	(1)
Dale silt loam	825	.1
Darnell-Stephenville fine sandy loams, 3 to 12 percent slopes	119,505	19.2
Darnell-Stephenville complex, 3 to 12 percent slopes, severely eroded	72,605	11.7
Dougherty loamy fine sand, 3 to 8 percent slopes	8,320	1.3
Eufaula-Dougherty complex, 5 to 12 percent slopes	5,145	.8
Kirkland silt loam, 0 to 1 percent slopes	1,720	.3
Konawa loamy fine sand, 0 to 3 percent slopes	5,240	.8
Konawa loamy fine sand, 3 to 8 percent slopes, severely eroded	5,645	.9
Lela clay	335	.1
Mason silt loam	5,230	.8
Miller clay	3,820	.6
Noble fine sandy loam, 3 to 8 percent slopes	6,410	1.0
Norge loam, 1 to 3 percent slopes	880	.1
Norge loam, 3 to 5 percent slopes	695	.1
Norge loam, 2 to 5 percent slopes, eroded	360	.1
Port clay loam, occasionally flooded	9,740	1.6
Port clay loam, frequently flooded	1,165	.2
Port loam, occasionally flooded	18,470	3.0
Pulaski fine sandy loam	25,975	4.2
Pulaski soils, wet	5,825	.9
Renfrow silt loam, 1 to 3 percent slopes	5,475	.9
Renfrow silt loam, 3 to 5 percent slopes	4,795	.8
Renfrow silty clay loam, 2 to 5 percent slopes, eroded	19,855	3.2
Renfrow-Vernon complex, 2 to 5 percent slopes, severely eroded	48,845	7.9
Roebuck clay	3,135	.5
Stephenville fine sandy loam, 1 to 3 percent slopes	7,765	1.2
Stephenville fine sandy loam, 3 to 5 percent slopes	20,885	3.4
Stephenville fine sandy loam, 2 to 5 percent slopes, eroded	9,815	1.6
Teller loam, 1 to 3 percent slopes	830	.1
Teller loam, 3 to 5 percent slopes	1,475	.2
Teller loam, 2 to 5 percent slopes, eroded	3,900	.6
Vanoss loam, 0 to 1 percent slopes	560	.1
Vanoss loam, 1 to 3 percent slopes	2,425	.4
Vanoss loam, 1 to 3 percent slopes, eroded	2,170	.3
Vernon clay loam, 3 to 5 percent slopes	6,870	1.1
Vernon-Collinsville complex, 5 to 20 percent slopes	9,940	1.6
Vernon-Lucien complex, 5 to 15 percent slopes	36,815	5.9
Wet alluvial land	3,080	.5
Yahola clay loam	1,665	.3
Yahola fine sandy loam	3,065	.5
Zaneis loam, 3 to 5 percent slopes	3,830	.6
Zaneis loam, 3 to 5 percent slopes, eroded	2,775	.4
Rivers and other water	5,295	.8
Borrow pits and rock pits	135	(1)
Total	622,720	100.0

1 Less than 0.05 percent.

331-682—69——2

Typical profile of Bonham loam, 3 to 5 percent slopes (in a meadow, about 1,900 feet north and 200 feet west of the southeast corner of section 15, T. 15 N., R. 6 E.):

A1—0 to 12 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; slightly acid; gradual, smooth boundary; horizon 10 to 18 inches thick.

B1—12 to 20 inches, dark-brown (10YR 4/3) heavy loam, dark brown (10YR 3/3) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; slightly acid; gradual, smooth boundary; horizon 4 to 10 inches thick.

B21t—20 to 30 inches, brown (10YR 5/3) heavy silty clay loam, dark brown (10YR 4/3) when moist; many, medium, distinct mottles of dark reddish brown; moderate, fine, subangular blocky structure; hard when dry, firm when moist; distinct continuous clay films; slightly acid; gradual boundary; horizon 7 to 14 inches thick.

B22t—30 to 44 inches, yellowish-brown (10YR 5/4) heavy silty clay loam, dark yellowish brown (10YR 4/4) when moist; few, fine, distinct mottles of yellowish red; moderate, medium, subangular blocky structure; very hard when dry, firm when moist; distinct continuous clay films; few ferromagnesium concretions; neutral; gradual boundary; horizon 8 to 16 inches thick.

B31—44 to 52 inches, brown (7.5YR 5/4) heavy silty clay loam, dark brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; very hard when dry, firm when moist; several ferromagnesium concretions; mildly alkaline; gradual boundary; horizon 6 to 16 inches thick.

B32—52 to 66 inches +, light yellowish-brown (10YR 6/4) and brown (7.5YR 5/4) heavy silty clay loam, yellowish brown (10YR 5/6) and dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; very hard when dry, firm when moist; many ferromagnesium concretions; few calcium carbonate concretions; calcareous.

The A1 horizon is dominantly loam, but it is silt loam in small areas. It is brown to very dark grayish brown. Reaction ranges from slightly acid to neutral. The B2t horizon is heavy clay loam, light clay loam, and heavy silty clay loam. The upper part of the subsoil ranges from slightly acid to mildly alkaline. The lower part generally is calcareous but is alkaline in some places. Depth to calcareous material ranges from 40 to 66 inches or more.

The subsoil of Bonham soils is less sandy than that of the Chickasha soils. Bonham soils are browner, less red, and more loamy than Renfrow soils.

Bonham loam, 1 to 3 percent slopes (BoB).—This deep soil occurs in large areas. The largest areas are near Stroud and occur with more sloping Bonham soils. The loam surface layer of this soil grades to a thick silty clay loam subsoil and is similar to the surface layer in the profile described as typical for the series.

Included in mapping were areas of Chickasha loam that make up about 4 percent of the mapped acreage. A few scattered slickspots occur in some places.

This soil is suitable for most kinds of farming. Good to excellent native meadow plants, small grains, sorghums, and tame pasture plants are grown on this soil. Fertilizer is needed for optimum growth of small grains, alfalfa, and tame pasture. In some cultivated areas contour tillage, terraces, and use of crop residue are needed to control erosion. (Capability unit IIe-1; Loamy Prairie range site; woodland suitability group 2)

Bonham loam, 3 to 5 percent slopes (BoC).—This deep soil is moderately extensive and uniformly gently sloping. It has the profile described as typical for the Bonham series. It occurs in the eastern one-third of the county. The largest areas are north and northwest of Stroud.

Included in mapping were areas of Bonham loam, 2 to 5 percent slopes, eroded, that make up about 10 percent of the mapped acreage and occur in some cultivated fields. Also included were areas of Chickasha loam and small areas of Renfrow silt loam. The Chickasha loam makes up about 5 percent of mapped areas.

This soil is desirable for most kinds of farming. It is well suited to native grass meadow, small grains, sorghums, and tame pasture. Wheat is the crop most widely grown. Terraces are needed if this soil is cultivated. (Capability unit IIIe-2; Loamy Prairie range site; woodland suitability group 2)

Bonham loam, 2 to 5 percent slopes, eroded (BoC2).—This eroded soil occurs in areas where water concentrates. In many areas it forms the upper limits of established drainage patterns. It is dominant in the northeastern part of the county, where it is associated with other Bonham soils.

Except that the surface layer is thinner, this soil has a profile similar to the one described as typical for the series. The surface layer is about 6 inches thick. In many places this layer is more clayey than the one described for the series because clay loam to silty clay loam subsoil material has been mixed into it. Rills are numerous.

Included with this soil in mapping were areas of less eroded Bonham soils that make up as much as 40 percent of the unit. Other inclusions were areas of Chickasha loam and of Renfrow silt loam. The Chickasha loam makes up about 4 percent of the mapped acreage, and the Renfrow silt loam makes up about 2 percent.

This Bonham soil is used for cultivated crops, native range, and tame pasture. Crops commonly grown are small grains, sorghums, sericea lespedeza, and grasses. If cultivation continues, the loss of soil must be kept within allowable limits. Row crops should be grown only infrequently. Wheat or other sown crops can be grown continuously if adequate fertilizer is added and crop residue is managed effectively. These practices help to control erosion and loss of water. Terraces and contour tillage are essential. (Capability unit IIIe-5; Loamy Prairie range site; woodland suitability group 3)

Breaks-Alluvial Land Complex

Breaks-Alluvial land complex (Bk) consists of small areas of breaks and of alluvial land that are impractical to map separately because they are in such intricate patterns. Most areas are long and narrow. The areas range from 75 to 600 feet in width, but they are 100 to 300 feet wide in most places. About 25 to 30 percent of the complex is made up of alluvial land and 70 to 75 percent of breaks. Slopes vary but generally are less than 20 percent.

Natural drainageways in this complex drain the surrounding, more uniform areas. The breaks part consists of side slopes, and the adjoining alluvial land consists of lower, less sloping areas that carry excess water from the drainage basin to larger streams and rivers.

The breaks consist of soil material that is shallow to moderately deep over sandstone or shale in most places.

The soil material is deep over loamy material in some places on uplands where the breaks occur with Norge, Teller, or Vanoss soils. The texture of the surface layer is dominantly loamy but ranges from fine sandy loam to clay. The surface layer ranges from red to dark yellowish brown and dark grayish brown, depending on the color of soils nearby on uplands. Below the surface layer the soil material is clay, sandy clay loam, or clay loam. It is slightly acid or calcareous. In places shale or sandstone is exposed.

The alluvial land is lower than the breaks. It consists of stratified material that ranges from loam to clay loam. This material is dominantly red or reddish brown in the western two-thirds of the county, but in some of the eastern parts grayish-brown or brown material is more dominant. It is neutral or calcareous. During heavy rains, the alluvial land is flooded for short periods.

Because the breaks are steep and narrow and because the alluvial land is frequently flooded, this mapping unit is more suited to range than to cultivated crops. On the breaks the vegetation is mainly short and mid grasses. Switchgrass, little bluestem, and indiangrass are abundant on the alluvial land. Elm, cottonwood, and oak trees also grow there. (Capability unit VIe–7; breaks are in the Loamy Prairie range site, and alluvial land is in the Loamy Bottomland range site; woodland suitability group 4)

Broken Alluvial Land

Broken alluvial land ((Br) consists of small, narrow, broken areas that are irregular in shape and lie on the bottom lands. These areas are frequently flooded. They were formed when the bottom lands were dissected by meandering small streams. Where the streams are larger and less meandering, some of the areas are as large as 5 acres. The areas range from 100 to 300 feet in width. Slopes vary but range from 0 to 15 percent in most places. Broken alluvial land gradually slopes downstream.

Frequent flooding, inaccessibility, and the small size of most areas make this land type generally unsuitable for cultivation. Most areas are covered by cottonwood, elm, hackberry, pecan, and willow trees, and by an understory of vines and tall grasses. Tall grasses cover the less shaded areas between the trees. This land is suitable for limited grazing and is an excellent wildlife habitat. (Capability unit Vw–2; Loamy Bottomland range site; woodland suitability group 2)

Chickasha Series

The Chickasha series consists of dark, loamy soils that are deep to moderately deep and mainly are very gently sloping to gently sloping. These soils occur in large areas on uplands northeast of Agra in the north-central part of the county and near Prague in the southeastern part. They developed in material weathered from sandstone under tall prairie grasses.

In a typical profile the surface layer is dark grayish-brown loam about 10 inches thick. The subsoil is about 32 inches thick. Its upper 5 inches is brown sandy clay loam that grades to a yellowish-brown sandy clay loam. Below a depth of about 34 inches, the subsoil is brown sandy clay loam mottled with yellowish red. Hard, yellowish-red sandstone is at a depth of about 42 inches.

Chickasha soils are among the more desirable soils on uplands in the county. They are moderately fertile, moderately permeable, and adequately drained. They are well adapted to both winter and summer crops.

Typical profile of Chickasha loam, 1 to 3 percent slopes (in a cultivated field, 1,300 feet north and 250 feet west of the southeast corner of section 36, T. 17 N., R. 4 E.):

A1—0 to 10 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; porous; many roots; slightly acid; clear boundary; horizon 8 to 12 inches thick.

B1—10 to 15 inches, brown (10YR 4/3) light sandy clay loam, dark brown (10YR 3/3) when moist; moderate, medium and fine, subangular blocky structure; hard when dry, friable when moist; slightly acid; gradual boundary; horizon 4 to 8 inches thick.

B2t—15 to 34 inches, yellowish-brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) when moist; moderate, medium, subangular blocky structure; patchy clay films on ped faces and coatings on sand grains; hard when dry, firm when moist; few black concretions; slightly acid; gradual boundary; horizon 15 to 24 inches thick.

B3—34 to 42 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) when moist; common, fine, yellowish-red mottles; weak, medium, subangular blocky structure; bridges on sand grains; hard when dry, friable when moist; slightly acid; abrupt, irregular boundary; horizon 6 to 12 inches thick.

R—42 inches +, hard, yellowish-red sandstone; augered with difficulty when moist.

The A1 horizon is dominantly loam but is heavy fine sandy loam in some places. It is brown to very dark grayish brown. The B horizon is brown to yellowish brown in most places, and in some places it is mottled with reddish and grayish colors in the lower part. The B horizon ranges from light sandy clay loam to clay loam that has clay content of less than 35 percent. Depth to sandstone ranges from 20 to about 48 inches. Throughout the profile reaction is medium acid to neutral.

Chickasha soils contain more sand but less clay in the subsoil than Bonham soils. They are less red than Zaneis soils and lack the light-colored A2 horizon that is characteristic of Stephenville soils. Chickasha soils are less clayey than Renfrow soils.

Chickasha loam, 1 to 3 percent slopes (CaB).—This deep soil occurs along ridgetops. Its profile is the one described as typical for the series.

Included in the mapping were small areas of Stephenville soil that make up about 3 percent of the mapped acreage. Also included were small areas of Renfrow, Bonham, and Zaneis soils.

This Chickasha soil has good water-holding capacity, and it is easy to till. It is moderately susceptible to erosion.

About 40 percent of the soil is in native pasture and range; about 25 percent is cultivated to peanuts, grain sorghum, and other crops; about 20 percent is in bermudgrass; and about 15 percent lies idle. The areas in bermudagrass are commonly overseeded to rye and vetch. Some of the native meadows are excellent.

The main crops are winter wheat, oats, barley, sorghums, cotton, and grasses. If row crops are planted, this soil should be terraced and farmed on the contour. Small grains can be grown continuously where fertilizer is added and stubble mulching is used. (Capability unit

IIe-1; Loamy Prairie range site; woodland suitability group 2)

Chickasha loam, 3 to 5 percent slopes (CaC).—This soil occurs on uplands with Zaneis, Bonham, and other Chickasha soils.

The profile for this soil is similar to the one described as typical for the Chickasha series, but the surface layer generally is slightly thinner. Also, depth to sandstone generally is about 34 inches, except at the lower parts of slopes where accumulations of colluvial material are thick.

Included with this soil in mapping were small areas of Renfrow and Zaneis soils. Also included, north of Stroud, were small areas of Bonham soils.

About 50 percent of this soil is in fair to excellent native meadow and range; about 25 percent is in old fields that lie idle or that furnish small amounts of poor-quality forage; about 15 percent is in tame pasture; and the remaining 10 percent is cultivated to peanuts, small grains, sorghums, and other crops.

This soil is well suited to cultivation, but it is susceptible to water erosion. The main crops are winter wheat and sorghums and legumes and grasses, though most other crops common in the county can be grown. Small grains can be grown continuously if this soil is terraced and tilled on the contour, adequate fertilizer is added, and crop residue is used effectively. (Capability unit IIIe-2; Loamy Prairie range site; woodland suitability group 2)

Chickasha loam, 2 to 5 percent slopes, eroded (CaC2).—This eroded soil occurs on uplands where water concentrates. About 30 percent of the soil has slopes of 2 to 3 percent, and the rest has slopes of 3 to 5 percent.

Because of erosion, the surface layer of the soil is thinner than the one in the profile described as typical for the series. It ranges from 4 to 8 inches in thickness but generally is about 6 inches thick. In small areas all of the original surface layer has been removed by erosion and subsoil material is exposed. As a result, the existing surface layer is more clayey than the original one. In most places the plow layer consists of material from the surface layer mixed with material from the upper part of the subsoil. Rills are common, and in a few places fragments of sandstone are scattered over the surface.

Included with this soil in mapping were small areas of an eroded Zaneis loam and of a Bonham loam, each of which makes up about 4 percent of the area mapped. Also included, and making up about 3 percent, were small areas of an eroded Renfrow silty clay loam.

About 70 percent of this soil is in native range or idle cropland; about 20 percent is cultivated to peanuts, small grains, and sorghums; and the remaining 10 percent is in tame pasture. Native grasses can be reestablished on this soil, and in places establishing tame pasture is feasible. Crops commonly grown are small grains, sorghums, sericea lespedeza, and native grasses. Because water erosion is a serious hazard, row crops should not be planted. Small grains can be grown continuously if fertilizer is added and crop residue is used. Terraces and contour tillage are needed. (Capability unit IIIe-5; Loamy Prairie range site; woodland suitability group 3)

Chickasha and Bonham soils, 2 to 6 percent slopes, severely eroded (CbC3).—These soils have been sheet eroded and gullied. They occur mostly in the eastern part of the county. The largest areas of the Chickasha soils are in the northeastern part near Agra. Except that its surface layer is thinner, each of the soils has a profile similar to the one described as typical for its respective series.

Chickasha soils make up about 40 percent of the mapping unit, and Bonham soils make up about 30 percent. In about 20 percent of the acreage, all of the dark surface layer has been lost through erosion. The rest is included areas of Zaneis, Teller, Norge, and Vanoss soils.

Gullies that cannot be crossed by farm machinery occur in about 70 percent of the acreage. They commonly are 50 to 400 feet apart. Most of them are 2 to 5 feet wide, but in the colluvial deposits at lower ends of slopes many are much wider and deeper. The soils between the gullies are moderately to severely sheet eroded.

These soils were cultivated, but most of the acreage is now in low quality native range. About 15 percent has been sprigged to bermudagrass. Shaping of gullies generally is needed before sprigging can be effective. These soils support native grasses of poor quality and weeds, but a good cover of little bluestem, switchgrass, and indiangrass, or of tame pasture plants, could be established in the more loamy, less eroded areas. In some areas the use of diversion terraces around upper ends of gullies helps to obtain a good cover of these desirable grasses. (Capability unit VIe-6; Eroded Prairie range site; woodland suitability group 3)

Collinsville Series

The Collinsville series consists of loamy soils that are very shallow to shallow over slightly acid sandstone. These soils are sloping to moderately steep and occur on prairies, mainly in the northeastern part of the county. They formed under tall grasses.

In a typical profile the surface layer is brown, slightly acid fine sandy loam about 5 inches thick. The subsoil is also brown fine sandy loam about 5 inches thick, but it contains a few scattered fragments of sandstone. Underlying the subsoil is brownish-yellow and white, hard sandstone.

Collinsville soils are excessively drained. Because they are very shallow to shallow, their capacity to hold water and to retain plant nutrients is low. Much of the underlying sandstone is fractured and is penetrated by some roots.

The soils of this series are chiefly in range, mainly because they are droughty and susceptible to erosion.

Collinsville soils are mapped only in a complex with Vernon soils.

Typical profile of a Collinsville soil (5 to 20 percent slopes) in a native grass pasture (about 175 feet east and 300 feet south of the northwest corner of section 32, T. 17 N., 6 E.):

A1—0 to 5 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) when moist; moderate, fine, granular structure; slightly hard when dry, very friable when moist; slightly acid; gradual boundary; horizon 4 to 10 inches thick.

B—5 to 10 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; moderate, medium, granular structure; slightly hard when dry, friable

when moist; few scattered sandstone fragments; medium acid; gradual boundary; horizon 0 to 10 inches thick.

R—10 inches +, brownish-yellow (10YR 6/6) and white (10YR 8/2) sandstone; hard; slightly acid.

Color of the A1 horizon is mostly brown, in hue of 10YR to 7.5YR. This layer is dominantly fine sandy loam but is loam in some areas. The B horizon ranges from pale brown to dark brown and yellowish brown. Texture ranges from loam to fine sandy loam. The surface layer and subsoil range from slightly acid through strongly acid. Depth to partly weathered and fractured sandstone ranges from 4 to 15 inches.

Collinsville soils are more brownish than Lucien soils and have lower pH values. They lack the lighter colored subsoil that is characteristic of Darnell soils, which formed under forest vegetation instead of tall native grasses. Collinsville soils are shallower than the associated Bonham and Chickasha soils.

Crevasse Series

The Crevasse series consists of soils that formed in recent deposits of sandy alluvium on the lowest parts of bottom lands along the North Canadian River. These soils are sandy and calcareous.

In a typical profile the surface layer is light yellowish-brown, calcareous loamy fine sand about 20 inches thick. The underlying material is highly stratified, calcareous fine sand that is easily penetrated by roots.

Crevasse soils are rapidly permeable. They are well drained to excessively drained and have low fertility. Flooding is occasional to frequent, and there is some scouring in most years.

Typical profile of Crevasse loamy fine sand in native range (about 1,800 feet east and 2,200 feet north of the southwest corner of section 31, T. 12 N., R. 2 E.):

A1—0 to 20 inches, light yellowish-brown (10YR 6/4) loamy fine sand, dark brown (10YR 4/3) when moist; very weak, fine, granular structure; loose; calcareous; gradual, smooth boundary; 10 to 25 inches thick.

C—20 to 54 inches +, very pale brown (10YR 7/4) fine sand, yellowish brown (10YR 5/4) when moist; ingle grained; loose; calcareous.

The A1 horizon generally is loamy fine sand, but fine sand occurs in some areas. Color ranges from light yellowish brown to brown. The C horizon dominantly is fine sand that has strata of sand and more loamy material. Color ranges from very pale brown to yellowish brown. In some places thin strata of sand and clay occur in the C horizon.

Throughout the profile Crevasse soils are sandier and browner than Yahola or Pulaski soils. Crevasse soils are calcareous, but Pulaski soils are not.

Crevasse loamy fine sand (0 to 3 percent slopes) (Cr).—This soil occurs on bottom lands and is occasionally to frequently flooded. About 20 percent of this soil consists of stabilized sand dunes less than 6 feet high. Most of these dunes parallel the North Canadian River within 300 feet of it.

The profile of this soil is the one described as typical for the series, but the surface layer varies in texture because new material is deposited during floods. Thin strata of sand to clay are common.

Included in mapping were areas of Yahola soils that occur in the lower, more frequently flooded bottom lands. These included areas make up about 7 percent of the acreage mapped.

This soil is not well suited to cultivated crops, because it has low fertility and is susceptible to soil blowing and flooding. Most of the soil is in native range. The vegetation is mainly bluestem, switchgrass, and a scattering of cottonwood and elm trees. Small grains have been drilled in a few places for use as winter pasture. A mixture of a small grain and a legume, such as rye and vetch, can be grown continuously if crop residue is used effectively and fertilizer is added. (Capability unit IIIe-7; Sandy Bottomland range site; woodland suitability group 1)

Dale Series

The Dale series consists of nearly level soils that are deep, dark, and loamy. Dale soils occur on benches of the North Canadian River and are seldom flooded. They are near the southwestern corner of Lincoln County.

In a typical profile the surface layer is dark grayish-brown silt loam about 22 inches thick. The subsoil is neutral, brown silt loam that generally extends to a depth of about 34 inches. It is underlain by calcareous, light yellowish-brown very fine sandy loam.

These soils are well drained and are high in natural fertility. They have good capacity to retain moisture that plants can use.

Typical profile of Dale silt loam in a cultivated field on a nearly level area (about 1,500 feet east and 600 feet north of the southwest corner of section 30, T. 12 N., R. 2 E.):

A1—0 to 22 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; hard when dry, friable when moist; slightly acid; gradual boundary; horizon 15 to 26 inches thick.

B—22 to 34 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) when moist; moderate, medium, granular structure; slightly hard when dry, friable when wet; neutral; clear boundary; horizon 8 to 20 inches thick.

C—34 to 55 inches +, light yellowish-brown (10YR 6/4) very fine sandy loam, dark yellowish brown (10YR 4/4) when moist; very soft when dry, very friable when moist; calcareous.

The A1 horizon is dominantly silt loam but, in small areas, is very fine sandy loam to light silty clay loam. It is dark grayish brown to dark brown. Reaction ranges from slightly acid to neutral. The B horizon is silt loam to silty clay loam. The C horizon generally ranges from very fine sandy loam to silt loam, but in a few places it is more clayey or more sandy in the lower part. The C horizon is pale brown to yellowish brown. Depth to calcareous material ranges from about 24 to 40 inches.

Dale soils contain less clay than the somewhat poorly drained Lela soils. Dale soils are darker than Port soils and are less calcareous and less stratified than Yahola soils.

Dale silt loam (0 to 1 percent slopes) (Da).—This is one of the more desirable soils for farming in the county. It occurs in uniform areas that are seldom flooded.

Included with this soil in mapping were areas of silty clay loam that make up about 30 percent of the acreage mapped. Also included were areas that have stratified layers of clay loam and silty clay loam below a depth of 25 inches.

Most of Dale silt loam is cultivated. This soil is easy to till and is well adapted to most crops commonly grown in the county. Commonly grown are small grains, alfalfa, corn, grain sorghum, and cotton. The main crops are winter wheat and alfalfa. Peanuts also are grown, but they are difficult to harvest because the soil is sticky.

The main concerns in managing this soil are maintaining fertility and soil structure. An example of a suitable cropping system is 2 years of grain sorghum or another row crop followed by alfalfa or a small grain grown for several years. Crop residue should be used effectively and fertilizer added. (Capability unit I-1; Loamy Bottomland range site; woodland suitability group 1)

Darnell Series

The Darnell series consists of shallow to very shallow loamy soils. These soils range from gently sloping to strongly sloping but are strongly sloping in most places. They generally occupy rough areas in the uplands. Darnell soils occur in large areas near the western edge of the county and in smaller areas in other parts.

In a typical profile the surface layer is brown fine sandy loam about 4 inches thick. This layer is medium acid. The subsoil has weak, fine granular structure and consists of light-brown loamy fine sand about 10 inches thick. It rests on slightly weathered, medium acid, red sandstone (fig. 4). In the sandstone are cracks that can be penetrated by plant roots.

Figure 4.—**Profile of a Darnell fine sandy loam showing the sandstone parent material.**

Darnell soils are somewhat excessively drained. Runoff is rapid, and permeability is moderately rapid. Water-holding capacity and natural fertility are low. These soils are susceptible to water erosion if they are not managed well.

Typical profile of a Darnell fine sandy loam, 3 to 12 percent slopes, about 975 feet west and 100 feet north of the southeast corner of section 17, T. 16 N., R. 2 E.):

A1—0 to 4 inches, brown (10YR 5/3) light fine sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; loose when dry, very friable when moist; medium acid; clear boundary; horizon 2 to 6 inches thick.

B—4 to 14 inches, light-brown (7.5YR 6/4) loamy fine sand, dark brown (7.5YR 4/4) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; medium acid; gradual boundary; horizon 2 to 16 inches thick.

R—14 to 18 inches +, red (10R 4/6) hard sandstone, dark red (10R 3/6) when moist; medium acid; very hard when dry, difficult to auger when moist.

The color of the A1 horizon ranges from brown or dark grayish brown to pale brown. The B horizon is fine sandy loam or loamy fine sand. The underlying sandstone ranges from dark reddish brown to reddish yellow or red. It is at depths ranging from a few inches to 20 inches. In some areas a layer of loam or sandy loam, 1 to 4 inches thick, overlies the R horizon. This layer contains sandstone fragments in some places. In other places there is an intermittent B2t horizon that is 2 to 12 inches thick. This layer is similar to the B2t horizon of Stephenville soils.

Darnell soils are less than 20 inches deep over sandstone, whereas the associated Stephenville soils range from 20 to 48 inches deep over sandstone. Darnell soils are less clayey than Vernon soils and are more brownish, more sandy, and more acid than Lucien soils.

Darnell-Stephenville fine sandy loams, 3 to 12 percent slopes (DsF).—These soils occur in large areas on uplands in the western part of the county. Darnell soil makes up about 60 percent of the mapping unit; Stephenville soil, about 30 percent. Noble, Lucien, Vernon soils and rock outcrops make up the remainder. The Darnell and Stephenville soils occur in such an intricate pattern that it is impractical to map each kind of soil separately.

The profile of the Darnell soil is the one described as typical for the Darnell series. The profile of the Stephenville soil is similar to the one described as typical for the Stephenville series, but depth to sandstone is 26 inches instead of 40.

Most of this mapping unit is in a mixture of native woods and grasses and is used for grazing and as wildlife habitat. Blackjack and post oak trees grow in dense stands, and native grasses cover the more open areas. These soils are not suitable for cultivation. (Both soils are in capability unit VIe-5; Darnell soil is in Shallow Savannah range site, and Stephenville soil is in Sandy Savannah range site; both soils are in woodland suitability group 3)

Darnell-Stephenville complex, 3 to 12 percent slopes, severely eroded (DtE3).—This complex consists mainly of areas of Darnell and Stephenville soils that were formerly cultivated but now are so eroded that they are no longer suitable for cultivation. These areas are dissected by gul-

lies at intervals of 50 to 200 feet. Between the gullies the degree of erosion varies.

This complex is about 40 percent Darnell soils; about 25 percent Stephenville soils; about 10 percent Noble fine sandy loam, 3 to 8 percent slopes; about 10 percent rock outcrops; and about 15 percent a soil less than 4 inches deep over sandstone. The Stephenville soils are dominant along ridgetops, and the Darnell soils are dominant on the steeper parts of side slopes.

The Darnell part of this complex is typified by 8 inches of fine sandy loam over sandstone. The Stephenville part is typified by 5 inches of fine sandy loam over a sandy clay loam subsoil that rests on sandstone at a depth of 22 inches. In most places, the plow layer of both soils is a mixture of the original surface layer and the subsoil. In some areas of both soils all of the soil material has been removed and sandstone is exposed.

These severely eroded soils are low in natural fertility. They are highly susceptible to accelerated erosion.

Much of this complex is abandoned cropland. In places grasses of poor quality grow in thin stands, but native grasses grow well where they have been planted. At considerable expense some gullied areas have been shaped and sprigged with bermudagrass. (Both soils are in capability unit VIe–3); Darnell soils are in Eroded Shallow Savannah range site and Stephenville soils are in Eroded Sandy Savannah range site; both soils are in woodland suitability group 4)

Dougherty Series

In the Dougherty series are deep, light-colored, acid, sandy soils that occur on forested uplands. These soils are gently sloping to strongly sloping. The largest areas are north of both the Deep Fork North Canadian River and the North Canadian River.

In a typical profile the plow layer is pale-brown loamy fine sand about 5 inches thick. The next layer is very pale-brown loamy fine sand about 21 inches thick. The subsoil is about 24 inches thick and is yellowish red. The upper part is medium acid sandy clay loam and the lower part is fine sandy loam. The underlying material is yellowish-red loamy fine sand that is stratified with thin bands of fine sandy loam.

These soils are moderately permeable and well drained. Natural fertility and water-holding capacity are moderately low. Cultivated areas are susceptible to soil blowing.

Typical profile of Dougherty loamy fine sand, 3 to 8 percent slopes (about 800 feet east and 450 feet north of the southwest corner of section 33, T. 14 N., R. 5 E.):

Ap—0 to 5 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) when moist; weak, fine, granular structure; soft when dry, very friable when wet; neutral; clear boundary; horizon 4 to 8 inches thick.

A2—5 to 26 inches, very pale brown (10YR 7/4) loamy fine sand, yellowish brown (10YR 5/4) when moist; massive; soft when dry, very friable when moist; medium acid; clear boundary; horizon 16 to 36 inches thick.

B2t—26 to 38 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; weak, medium, subangular blocky structure; patchy clay film on ped faces; very hard when dry, firm when moist; medium acid; diffuse boundary; horizon 12 to 25 inches thick.

B3—38 to 50 inches, yellowish-red (5YR 5/8) fine sandy loam, yellowish red (5YR 4/8) when moist; weak, coarse, subangular blocky structure; hard when dry, friable when moist; medium acid; diffuse boundary; horizon 10 to 20 inches thick.

C—50 to 55 inches +, yellowish-red (5YR 5/8) loamy fine sand, yellowish red (5YR 4/8) when moist; massive; stratified with thin bands of fine sandy loam; medium acid.

The A horizon is loamy fine sand in most places, but in some cultivated areas it is fine sand. The Ap horizon ranges from pale brown to dark grayish brown, and the A2 horizon is very pale brown to pale brown and light yellowish brown. The B2t horizon is light sandy clay loam or medium sandy clay loam in texture and is reddish yellow to reddish brown in color. Its hue is 2.5YR to 7.5 YR. Reaction is medium acid or strongly acid. The C horizon is mainly loamy fine sand but ranges to light sandy clay loam. In a few areas bands of sandy loam to light sandy clay loam that are ⅛ inch to 3 inches thick occur in the B3 and C horizons.

Dougherty soils have a subsoil that occurs at depths between 20 and 40 inches and is sandy clay loam in the upper part, but the more sandy Eufaula soils have a fine sandy loam subsoil at a depth of more than 40 inches. In contrast, the subsoil of Konawa soils is at a depth of less than 20 inches.

Dougherty loamy fine sand, 3 to 8 percent slopes (DuD).—This soil occurs in Lincoln County on uplands. It is highly susceptible to soil blowing and, in the more sloping areas, gully erosion is likely.

Included in mapping were a few areas of Teller loam and a loamy fine sand in the Eufaula-Dougherty complex. Also included were small areas of Konawa soils that have a sandy clay loam subsoil at a depth of less than 20 inches. The included areas of Konawa soils make up about 15 to 20 percent of the area mapped.

This Dougherty soil is better suited to native grasses than to cultivated crops, but small areas are in small grains. Crops do not grow well year after year, because the soil is loose and sandy and has moderately low natural fertility and water-holding capacity. If this soil is used for crops, they should be sown crops, such as rye and vetch, winter oats, forage sorghum, and tame grasses. These crops respond well if fertilizer is added and cover is maintained at all times. Row crops should not be planted. (Capability unit IVe–4; Deep Sand Savannah range site; woodland suitability group 2)

Eufaula Series

In the Eufaula series are deep, medium acid, loose, sandy soils. These soils are sloping and strongly sloping and occur on uplands, mostly north of the Deep Fork North Canadian River. A smaller acreage is north of the North Canadian River in the southwestern corner of the county.

In a typical profile the upper part of the surface layer is brown fine sand about 4 inches thick, and the lower part is pink fine sand about 46 inches thick. Reaction is medium acid. The yellowish-red fine sandy loam subsoil occurs at a depth of about 50 inches. It is strongly acid.

Eufaula soils are excessively drained. Internal drainage and permeability are rapid. Water-holding capacity and natural fertility are low. Eufaula soils are very susceptible to soil blowing and water erosion.

Typical profile of Eufaula fine sand (5 to 12 percent slopes) in a wooded area (about 2,000 feet east and 75 feet south from the northwest corner of section 31, T. 14 N., R. 5 E.):

A1—0 to 4 inches, brown (10YR 5/3) fine sand, dark brown (10YR 3/3) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; medium acid; clear boundary; horizon 2 to 8 inches thick.

A2—4 to 50 inches, pink (7.5YR 7/4) fine sand, brown (7.5YR 5/4) when moist; single grain; loose when dry or moist; medium acid; clear boundary; horizon 36 to 60 inches thick.

B2t—50 to 60 inches, yellowish-red (5YR 5/8) fine sandy loam, yellowish red (5YR 5/8) when moist; massive; thin coatings on sand grains and weak bridges between the grains; soft when dry, very friable when moist; strongly acid; gradual boundary; horizon 6 to 20 inches thick.

The A1 horizon is dominantly fine sand, but it is loamy fine sand in about 20 percent of the area mapped. In color the A1 horizon ranges from very pale brown to brown. The A2 horizon is pale brown to pink. Depth to the B2t horizon ranges from 40 to 60 inches. This horizon is loamy sand to light sandy clay loam in texture and is reddish yellow to reddish brown in color.

In Eufaula soils the A horizons are thicker than those in the Dougherty soils. The subsoil of Eufaula soils occurs below a depth of 40 inches, but that of Dougherty soils occurs at a depth of 20 to 40 inches. Eufaula soils are more sandy than the associated Teller and Stephenville soils.

Eufaula-Dougherty complex, 5 to 12 percent slopes (EdE).—This complex is on sandy uplands and consists of soils that are so closely intermingled that it is impractical to map them separately. Eufaula soils make up about 50 percent of the area mapped; Dougherty soils, about 40 percent; and Konawa soils, the remaining 10 percent. The Eufaula soils are steeper than the Dougherty soils and have slopes that normally face north or east. In most places Dougherty soils have slopes of less than 8 percent that face south or west. Konawa soils generally occur on ridge crests and are more nearly level than the Dougherty soils.

The Eufaula soils have the profile described as the one typical for the Eufaula series. Except that the surface layer is thicker, the profile of the Dougherty soils is similar to the one described as typical for the Dougherty series.

Most areas of the soils in this mapping unit are in scrub oaks and in mid and tall native grasses. This complex is low in both natural fertility and water-holding capacity. It is highly susceptible to soil blowing and is not suited to cultivated crops. (Capability unit VIs-1; Deep Sand Savannah range site; woodland suitability group 2)

Kirkland Series

The Kirkland series consists of deep, dark, loamy soils that have a dense clay subsoil. Kirkland soils are nearly level and generally occur on divides between drainageways. These soils have a small acreage in Lincoln County. They formed under native grasses in alkaline clay and shale.

In a typical profile the surface layer is slightly acid, dark grayish-brown silt loam about 10 inches thick. The dense clay is between depths of 10 and 26 inches and consists of dark-brown, neutral clay. The next layer is yellowish-brown moderately alkaline clay. It is underlain by red, noncalcareous clay at a depth of about 36 inches.

Kirkland soils are well drained, have moderately high natural fertility; and are easy to till. Permeability and internal drainage are very slow. These soils are somewhat droughty for summer crops.

Typical profile of Kirkland silt loam, 0 to 1 percent slopes, in a cultivated field (about 2,000 feet west and 800 feet south from the northeast corner of section 6, T. 16 N., R. 3 E.):

A1—0 to 10 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; slightly acid; clear boundary; horizon 8 to 14 inches thick.

B2t—10 to 26 inches, dark-brown (10YR 4/3) clay, dark brown (10YR 3/3) when moist; moderate to weak, medium, blocky structure; extremely hard when dry, very firm when moist; continuous clay films; neutral; gradual, smooth boundary; horizon 12 to 20 inches thick.

B3—26 to 36 inches, yellowish-brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) when moist; weak, medium, blocky structure; extremely hard when dry, very firm when moist; patchy clay films; common, fine concretions of calcium carbonate; few, fine, black concretions of ferromagnesium; noncalcareous; moderately alkaline; diffuse boundary; horizon 6 to 14 inches thick.

C—36 to 52 inches +, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) when moist; massive; few, fine concretions of calcium carbonate; few, fine, black concretions of ferromagnesium; noncalcareous.

The A1 horizon is dominantly silt loam, but in a few places it is loam. It ranges from brown to very dark grayish brown. The B2t horizon ranges from dark grayish brown to dark brown in hue of 10YR and 7.5YR. The B3 horizon is dark yellowish brown to reddish brown. The C horizon is red or reddish brown in most places. Depth to the C horizon ranges from 30 to more than 50 inches.

Kirkland soils are closely associated with the more reddish, generally steeper Renfrow and Vernon soils. Kirkland soils are deeper than Vernon soils and have a more abrupt boundary between the A and B horizons than do the Renfrow or Bonham soils. The B horizon in Kirkland soils is slightly more clayey than that in Bonham soils.

Kirkland silt loam, 0 to 1 percent slopes (KnA).—This deep soil occurs in small areas on prairies through all parts of Lincoln County except the northeastern.

Included in mapping were scattered areas of Renfrow silt loam, of Chickasha loam, and of Zaneis loam. Also included were a few small areas that have a loam surface layer and a few small depressions that are moderately well drained.

Most Kirkland silt loam is cultivated, though tillage is difficult. Because of droughtiness, this soil is better suited to winter wheat, rye, barley, and other small grains than to summer crops. Wheat is the main crop. Grain sorghum, sweetclover, and grasses are also grown. This soil generally is adequately drained, but small areas are ponded in rainy periods.

Management is needed to decrease droughtiness and to maintain soil structure. Small grains can be grown year after year where crop residue is used properly and adequate fertilizer is added. (Capability unit IIs-1; Claypan Prairie range site; woodland suitability group 3)

Konawa Series

In the Konawa series are deep, sandy soils on uplands. These soils occur mostly north of the Deep Fork North Canadian River and north of the North Canadian River in the southwestern corner of the county. They formed in sandy to loamy old alluvium that has been worked by wind. The largest areas are nearly level to gently sloping. Konawa soils are wooded or were formerly wooded.

In a typical profile the upper part of the surface layer is grayish-brown loamy fine sand about 4 inches thick. The lower part, about 10 inches thick, is pale-brown loamy fine sand. The subsoil is yellowish red and about 26 inches thick. Its upper 18 inches is sandy clay loam, and its lower 8 inches is sandy loam. The underlying material is yellowish-red sandy loam that is slightly coarser textured than the layer above. Throughout the profile reaction is slightly acid to strongly acid.

Konawa soils are well drained and moderately permeable. Their ability to store moisture is moderate to low. Natural fertility is low.

Typical profile of Konawa loamy fine sand, 0 to 3 percent slopes (about 1,450 feet west and 275 feet south from the northeast corner of section 36, T. 14 N., R. 4 E.) :

A1—0 to 4 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; soft when dry, friable when moist; slightly acid; clear, wavy boundary; horizon 3 to 8 inches thick.

A2—4 to 14 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) when moist; massive; loose when dry or moist; medium acid; clear boundary; horizon 8 to 17 inches thick.

B2t—14 to 32 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; weak, medium, subangular blocky structure; patchy clay films; hard when dry, friable when moist; medium acid; gradual boundary; horizon 15 to 25 inches thick.

B3—32 to 40 inches, yellowish-red (5YR 5/8) sandy loam, yellowish red (5YR 4/8) when moist; massive; hard when dry, very friable when moist; strongly acid; gradual boundary; horizon 4 to 16 inches thick.

C—40 to 60 inches +, yellowish-red (5YR 5/8) light sandy loam, yellowish red (5YR 4/8) when moist; massive; very hard when dry, very friable when moist; strongly acid.

The A1 horizon is loamy fine sand in most places, but in a few places it is fine sandy loam. Color ranges from very pale brown to grayish brown. The A2 horizon is lighter in color. The A horizons are less than 20 inches thick. The B2t horizon ranges from reddish brown to reddish yellow in hue of 2.5YR to 7.5YR. Texture is heavy fine sandy loam to sandy clay loam. The C horizon is loamy fine sand to light clay loam. Throughout the profile reaction ranges from slightly acid to strongly acid.

Konawa soils are similar to Dougherty soils but have a thinner A horizon. Sandstone is at a depth of 48 inches or more in the Konawa soils but is nearer the surface in the Stephenville soils. Konawa soils are less sandy than Eufaula soils.

Konawa loamy fine sand, 0 to 3 percent slopes (KoB).—This deep, sandy soil occurs on uplands, where it is closely associated with Dougherty and Eufaula soils. Its profile is the one described as typical for the Konawa series. This soil occurs in a few large areas between 2 and 4 miles north of the Deep Fork North Canadian River.

Included with this soil in mapping were areas of a Dougherty soil that make up about 12 percent of the acreage mapped. Also included were areas that have a sandy clay loam subsoil that is finer textured than the one in this Konawa soil. In other included areas the subsoil is mottled with red and gray.

This Konawa soil has low natural fertility and is highly susceptible to soil blowing and water erosion. Crops respond well to additions of fertilizer. About one-third of this soil is cultivated. Wheat is the main crop, but there are large acreages of rye and vetch. Other crops are forage sorghum, cotton, and peanuts. Most areas can be cultivated to small grains year after year if tillage is minimum and timely, crop residue is used effectively, and fertilizer is added. (Capability unit IIIe-4; Deep Sand Savannah range site; woodland suitability group 2)

Konawa loamy fine sand, 3 to 8 percent slopes, severely eroded (KoD3).—This soil occupies uplands and is so eroded and gullied that it is not suitable for cultivation. Gully erosion is more severe than the sheet erosion, but both have been very active. Gullies that cannot be crossed by farm machinery occur at intervals of 50 to 300 feet and are 1 to 15 feet deep and 3 to 30 feet wide.

Between gullies the surface layer is generally brown loamy fine sand that is only 6 inches deep. It is about 8 inches thinner than the surface layer in the profile described as typical for the Konawa series. This thinner layer is a mixture of materials from the upper and lower parts of the original surface layer. The subsoil is red sandy clay loam, and the underlying material is loamy fine sand.

Included in mapping were areas of a Dougherty soil that make up about 20 percent of the mapped acreage and areas of a Eufaula soil that make up about 5 percent. In some included areas the subsoil is more yellowish than the one described as typical for the Konawa series.

Weeds and native grasses of poor quality are dominant in the present vegetation, but blackjack and post oak trees are coming back. The grasses can be improved by limiting the grazing. Then broomsedge bluestem would decrease and the more desirable little bluestem, indiangrass, and switchgrass would increase. Reseeding to desirable native grasses is a good practice. (Capability unit VIe-2; Deep Sand Savannah range site; woodland suitability group 3)

Lela Series

Soils of the Lela series consist of deep, dark, clayey alluvium. These soils are nearly level to slightly convex and occur on high bottom lands along the North Canadian River. They occupy a small acreage in Lincoln County.

In a typical profile the surface layer is dark-gray, neutral clay about 18 inches thick. It overlies a layer of dark grayish-brown, calcareous clay about 17 inches thick. The underlying material is dark reddish-gray, calcareous, clayey alluvium that is difficult for roots to penetrate.

Lela soils are high in natural fertility but are difficult to till. They are somewhat poorly drained and have very slow permeability. Water from bordering hills frequently floods the Lela soils, and they remain flooded for weeks during wet periods. In dry periods cracks form that are as much as 1 inch wide and 3 feet or more deep.

Typical profile of Lela clay in a cultivated field (about 500 feet west and 100 feet north of the southeast corner of section 30, T. 12 N., R. 2 E.) :

A1—0 to 18 inches, dark-gray (10YR 4/1) clay, black (10YR 2/1) when moist; moderate, fine, granular structure; very hard when dry, firm when moist; neutral; gradual boundary; horizon 14 to 22 inches thick.
AC—18 to 35 inches, dark grayish-brown (10YR 4/2) clay, very dark brown (10YR 2/2) when moist; weak, very fine, blocky structure; extremely hard when dry, very firm when moist; calcareous; gradual boundary; horizon 10 to 30 inches thick.
C—35 to 55 inches +, dark reddish-gray (5YR 4/2) clay, dark reddish brown (5YR 3/2) when moist; weak, fine, blocky structure; extremely hard when dry, very firm when moist; few calcium carbonate concretions; calcareous.

The A1 horizon ranges from 14 to 22 inches in thickness. Color ranges from dark grayish brown to very dark gray. Structure ranges from moderate, fine, granular to strong, coarse, granular. The AC horizon ranges from brown to very dark gray and from neutral to very strongly alkaline. The C horizon is dominantly clay but has strata of silty clay loam or clay loam.

Lela soils are darker than Miller and Roebuck soils and are not so reddish in the upper 30 inches.

Lela clay (0 to 1 percent slopes) (Lc).—This soil occurs in slightly depressional bottom lands that are away from the stream channel and adjacent to the uplands. Its profile is the one described as typical for the series. A few isolated areas occur in depressions that are about 1 foot below surrounding areas of Dale silt loam.

Included in mapping, and making up 12 percent of the acreage, were long, narrow strips of a soil that has a silty clay loam surface layer underlain by clay. Also included were small areas of Dale silt loam that make up about 5 percent of the mapped acreage.

Lela clay is excessively wet in years of average rainfall, but it is droughty in dry years. After heavy rains water often stands on the surface for several days. Tillage is difficult when this soil is wet or dry.

Most of this soil is cultivated. Many areas are farmed along with the more extensive Dale soils. Surface drainage is required for most crops commonly grown. The main crops are alfalfa and wheat, though sorghums and corn are sometimes planted. Crops, particularly alfalfa, are often drowned.

Concerns in managing this soil are the excess surface water, unfavorable soil structure, and droughtiness during dry years. If crop residue is used properly, a suitable cropping system would be 2 years of corn or another row crop followed by several years of a small grain. (Capability unit IIIw-1; Heavy Bottomland range site; woodland suitability group 3)

Lucien Series

In the Lucien series are shallow, loamy soils of the prairie. These soils are sloping to moderately steep and occur in the western part of the county. They formed under tall and mid grasses on weathered sandstone.

In a typical profile the surface layer is reddish-brown, natural loam about 4 inches thick. It overlies a slightly lighter reddish-brown, neutral loam subsoil. The subsoil, at a depth of about 12 inches, is underlain by reddish-brown sandstone that is hard when dry but softens on wetting.

Lucien soils are somewhat excessively drained and are moderately permeable. Their water-holding capacity is medium to low. Natural fertility is low, and erosion is likely in tilled areas.

Lucien soils are mapped only in a complex with Vernon soils.

Typical profile of Lucien loam, 5 to 15 percent slopes, in a native grass pasture (about 1,800 feet west and 75 feet north of the southeast corner of section 30, T. 12 N., R. 4 E.):

A1—0 to 4 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, granular structure; soft when dry, very friable when moist; neutral; gradual boundary; horizon 2 to 8 inches thick.
B—4 to 12 inches, reddish-brown (2.5YR 4/4) loam, dark reddish brown (2.5YR 3/4) when moist; moderate, medium, granular structure; hard when dry, friable when moist; neutral; gradual boundary; horizon 6 to 12 inches thick.
R—12 to 20 inches +, reddish-brown (2.5YR 4/4) sandstone; extremely hard when dry, but softens on wetting.

The A1 horizon is reddish brown in hue of 2.5YR to 5YR. This horizon is loam in most places, but in a few places it is fine sandy loam or clay loam. The B horizon is red, reddish brown, and yellowish red. It also is loam in most places, but in a few places it is light clay loam. Depth to the R horizon generally ranges from 10 to 20 inches. The R horizon is dominantly sandstone, but it has a few strata of siltstone. The profile is slightly acid to neutral in most places.

Lucien soils are shallower than Zaneis soils and contain less clay than Vernon soils. The A horizon of Lucien soils is darker, more loamy, and less sandy than that of Darnell soils.

Mason Series

The Mason series consists of deep, dark, nearly level soils on bottom lands. These soils occur in the eastern one-third of the county. Originally they were covered with trees and an understory of tall grasses.

In a typical profile the surface layer is dark grayish-brown silt loam about 16 inches thick. The subsoil is dark-brown silty clay loam about 26 inches thick. It is underlain by brown loam that is easily penetrated by roots. The profile is slightly acid throughout.

Mason soils are moderately fertile and are moderately slow in permeability. They are well suited to all crops commonly grown in the county.

Typical profile of Mason silt loam in a cultivated field (about 700 feet south and 200 feet east of the northwest corner of section 27, T. 16 N., R. 6 E.):

A1—0 to 16 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; slightly hard when dry, very friable when moist; slightly acid; gradual boundary; horizon 10 to 18 inches thick.
B21t—16 to 28 inches, dark-brown (10YR 3/3) silty clay loam, very dark brown (10YR 2/2) when moist; moderate, fine, subangular blocky structure; weak, patchy clay films on peds; hard when dry, firm when moist; slightly acid; gradual boundary; horizon 10 to 24 inches thick.
B22t—28 to 42 inches, dark-brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) when moist; few, fine, faint mottles of strong brown; moderate, medium, subangular blocky structure; hard when dry, firm when moist; slightly acid; horizon 10 to 16 inches thick.
C—42 to 55 inches +, brown (7.5YR 5/4) loam, dark brown (7.5YR 3/4) when moist; massive; hard when dry, friable when moist; slightly acid.

The A1 horizon is silt loam in most places, but in some places it is loam. Color ranges from brown to dark brown in

hue of 10YR to 7.5YR. The B2t horizon ranges from brown to very dark grayish brown. A few fine mottles that have high chroma are common in the B22t horizon. The C horizon normally has strata of loam to silty clay loam. Throughout the profile reaction ranges from slightly acid to neutral.

Mason soils are darker than Port soils and are more acid in the subsoil than Dale soils. Mason soils show greater textural development than Port or Dale soils.

Mason silt loam (0 to 1 percent slopes) (Ma).—The largest areas of this soil are near local streams a few miles north of Stroud, and some of these areas are several hundred acres in size. Included in mapping were small areas of Port loam and of Pulaski fine sandy loam.

Mason silt loam absorbs, stores, and releases water to crops very well. The soil is easy to till and is seldom flooded, though a few areas do require diversions to prevent flooding by water from adjacent uplands.

Most areas of Mason silt loam are cultivated. Crops commonly grown are alfalfa, wheat, sorghums, and corn; sometimes peanuts or cotton is planted. Bermudagrass has been sprigged in some fields.

Management concerns are maintaining soil structure and fertility. If crop residue is used and fertilizer is added, a suitable cropping system is 2 years of row crops followed by 5 years of alfalfa or a small grain. (Capability unit I-1; Loamy Bottomland range site; woodland suitability group 1)

Miller Series

The Miller series consists of deep, reddish-brown, clayey soils that are calcareous. These soils are nearly level or have slightly concave slopes. They occur on bottom lands along the Deep Fork North Canadian River and some of its tributaries. These soils formed in calcareous, clayey, weathered alluvium.

In a typical profile the surface layer is reddish-brown clay about 12 inches thick. It overlies a layer of reddish-brown, calcareous clay about 8 inches thick. Below this is reddish-brown calcareous clay that is difficult for roots to penetrate. This underlying calcareous clay extends to a depth of more than 50 inches.

Miller soils are fertile but are droughty and slowly permeable to both air and water. They are somewhat poorly drained. When these soils dry, large cracks appear at the surface.

Typical profile of Miller clay in a pasture of fescue (about 150 feet north and 400 feet east from the southwest corner of NW¼ of section 6, T. 13 N., R. 5 E.):

A1—0 to 12 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) when moist; weak, fine, subangular blocky structure; very hard when dry, very firm when moist; calcareous; gradual, smooth boundary; horizon 8 to 20 inches thick.

AC—12 to 20 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) when moist; weak, coarse, blocky structure; extremely hard when dry, extremely firm when moist; calcareous; gradual boundary; horizon 4 to 18 inches thick.

C—20 to 50 inches +, reddish-brown (2.5YR 4/4) clay, dark red (2.5YR 3/6) when moist; massive; very hard when dry, very firm when moist; calcareous.

The A1 horizon is clay in most places, but it is loamy in some recently flooded areas. Colors range from reddish brown to dark reddish brown. The AC horizon is dominantly clay that ranges from red to dark reddish brown. The massive clay of the C horizon is commonly stratified by thin layers of sandy to loamy soil material. The C horizon is red, yellowish red, or reddish brown.

Miller soils are not so poorly drained as Roebuck soils. Miller soils are more clayey than Port soils and are redder than Lela soils.

Miller clay (0 to 1 percent slopes) (Mc).—This nearly level soil is slightly depressional in some places. Large tracts of Miller clay are west of Warwick in an area along the Deep Fork North Canadian River. In most places this soil is at a distance from the river channel.

Included with the soil in mapping, and making up about 10 percent of the mapped acreage, were areas in which the surface layer is thinner and less clayey than the one in the profile described as typical for the series. Also included were small areas of Port clay loam, of Port loam, and of a Roebuck soil that together make up about 9 percent of the mapped acreage.

Miller clay is somewhat poorly drained and is difficult to farm. Most of it is flooded at least once every 3 years, and a considerable acreage is flooded every year.

Most of this soil is cultivated. Close-growing crops are better suited than row crops, but row crops can be grown. Crops commonly grown are wheat, alfalfa, oats, and sorghums. Crops are damaged by excessive water during rainy periods and by drought in dry periods. If crop residue is properly used, a suitable cropping system is 2 years of row crops followed by several years of small grains. (Capability unit IIIw-1; Heavy Bottomland range site; woodland suitability group 3)

Noble Series

In the Noble series are deep fine sandy loams that occur on colluvial foot slopes below Darnell and Stephenville soils on the uplands. Noble soils are gently sloping to sloping. They formed under oak trees and tall grasses in colluvium from the Darnell and Stephenville soils.

In a typical profile the surface layer is brown, medium acid fine sandy loam about 6 inches thick. The subsoil is red fine sandy loam about 22 inches thick. Below this is red, medium acid fine sandy loam that extends to a depth of more than 52 inches.

Noble soils are low in natural fertility. Their permeability is moderately rapid. If cultivated, these soils are susceptible to soil blowing and to very severe water erosion.

Typical profile of Noble fine sandy loam, 3 to 8 percent slopes (about 2,400 feet south and 150 feet east of the northwest corner of section 21, T. 16 N., R. 4 E):

A1—0 to 6 inches, brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 4/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist; medium acid; clear boundary; horizon 5 to 10 inches thick.

B—6 to 28 inches, red (2.5YR 4/6) fine sandy loam, dark red (2.5YR 3/6) when moist; weak, fine, granular structure; soft when dry, very friable when moist; medium acid; gradual boundary; horizon 10 to 30 inches thick.

C—28 to 52 inches +, red (2.5YR 4/6) fine sandy loam, dark red (2.5YR 3/6) when moist; massive; porous; slightly hard when dry, friable when moist; medium acid.

All horizons are dominantly fine sandy loam. The A1 horizon is brown or reddish brown. The B horizon ranges from yellowish red to dark reddish brown. Throughout the profile reaction ranges from medium acid to slightly acid.

Noble soils have a browner A1 horizon than Pulaski soils. Noble soils are sandier and less texturally developed than

Teller soils. Sandstone does not occur at a depth of less than 48 inches in the Noble soils, but it does in the Stephenville soils.

Noble fine sandy loam, 3 to 8 percent slopes (NbD).—This soil normally occurs on colluvial foot slopes that are below Darnell and Stephenville soils on the uplands and above Pulaski soils on the bottom lands. Included in mapping were small areas of Stephenville and Pulaski soils.

About 85 percent of this soil is in native wooded range. The native vegetation is dominantly red, post, and blackjack oaks. Because of the competition from these trees, grass is sparse. The remaining 15 percent of this soil is cultivated to peanuts, small grains, and sorghums or is in bermudagrass.

Noble fine sandy loam is not well suited to cultivated crops, mainly because it is sloping, is erodible, and receives runoff from the uplands. Terraces are needed to lessen loss of soil, and fertilizer is needed to increase plant growth. An example of a suitable cropping system is 2 years of small grain followed by several years of grasses or legumes. (Capability unit IVe–3; Sandy Savannah range site; woodland suitability group 2)

Norge Series

The Norge series consists of deep, dark, loamy soils that occur on uplands and are very gently sloping to gently sloping. The largest areas in the county are in the northwestern part. Norge soils formed under tall grasses in old loamy sediment.

In a typical profile the surface layer is dark-brown, neutral loam about 13 inches thick. The subsoil, about 35 inches thick, is reddish-brown to red clay loam that has moderately slow permeability and is slightly acid. The underlying material is neutral, red clay loam that extends to a depth of more than 64 inches. Roots penetrate this material fairly readily.

Norge soils are well drained. Internal drainage is medium, and water-holding capacity is moderate. Natural fertility is high.

Typical profile of Norge loam, 1 to 3 percent slopes, in a native grass meadow (about 2,000 feet south and 1,300 feet east from the northwest corner of section 35, T. 17 N., R. 2 E.):

A1—0 to 13 inches, dark-brown (7.5YR 4/4) loam, dark brown (7.5YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; neutral; gradual, smooth boundary; horizon 8 to 16 inches thick.

B1—13 to 18 inches, reddish-brown (5YR 4/3) light clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; hard when dry, friable when moist; slightly acid; gradual, smooth boundary; horizon 4 to 8 inches thick.

B21t—18 to 30 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown when moist; moderate, fine, subangular blocky structure; continuous clay films; hard when dry, firm when moist; slightly acid; gradual boundary; horizon 8 to 16 inches thick.

B22t—30 to 48 inches, red (2.5YR 4/6) clay loam, dark red (2.5YR 3/6) when moist; moderate, medium, subangular blocky structure; patchy clay films; hard when dry, firm when moist; few, fine, faint mottles of red; slightly acid; gradual boundary; horizon 10 to 25 inches thick.

C—48 to 64 inches +, red (2.5YR 5/6) clay loam, red (2.5YR 4/6) when moist; massive; hard when dry, firm when moist; neutral.

Texture of the A1 horizon is dominantly loam but includes some areas of silt loam. Color ranges from brown to dark brown or reddish brown. The B1 and B2t horizons range from clay loam to silty clay loam in texture and from dark reddish brown to yellowish red in color. Reaction throughout the profile ranges from slightly acid to neutral.

Norge soils have a more clayey subsoil than Teller soils and a less silty, more reddish subsoil than Vanoss soils. Norge soils were not formed in material weathered from sandstone, but the Zaneis soils were.

Norge loam, 1 to 3 percent slopes (NoB).—This is the deep, dark loam that has the profile described as typical for the series. It occurs in small areas of the uplands in the northwestern corner of the county. Included with this soil in mapping were small areas of Teller, Vanoss, and Renfrow soils.

Most of this Norge soil is used for wheat or alfalfa, but oats, rye, sorghums, and cotton also are grown. Before the soil was cultivated, it supported lush stands of native grasses. Important grasses were little bluestem, indiangrass, and switchgrass. Grasses remain lush in a few scattered stands.

In managing this soil the main concerns are controlling erosion and maintaining fertility. If stubble mulching is used and fertilizer is added, small grains can be grown year after year. Tillage is easy. Row crops can be planted if terraces and contour farming are used. (Capability unit IIe–1; Loamy Prairie range site; woodland suitability group 2)

Norge loam, 3 to 5 percent slopes (NoC).—This soil occurs in the northwestern part of the county. It occurs mainly with other Norge soils and with Teller and Zaneis soils.

Except that its surface layer is thinner, this soil has a profile similar to the one described as typical for the series.

Included with this soil in mapping were areas of Zaneis loam that make up about 8 percent of the mapped acreage and small areas of Renfrow silt loam and of Teller loam that each make up about 2 percent. Also included, in cultivated fields, were areas of Norge loam, 2 to 5 percent slopes, eroded, that make up about 8 percent.

Norge loam, 3 to 5 percent slopes, is moderately easy to till. Some areas are in native range, and others are cultivated mainly to wheat and sorghums. When cultivated, however, this soil is susceptible to water erosion. But crops common in the county, such as small grains, sorghums, and cotton, can be grown if crop residue is used and fertilizer is added. In addition to crop residue and fertilizer, terraces and contour farming are needed if good growth of crops is to be continuous. (Capability unit IIIe–2; Loamy Prairie range site; woodland suitability group 2)

Norge loam, 2 to 5 percent slopes, eroded (NoC2).—This eroded soil has a thinner surface layer than that of Norge loam, 1 to 3 percent slopes. The surface layer is less than 6 inches thick. In most areas, the plow layer is a mixture of the surface layer and subsoil and is slightly more clayey and reddish than the plow layer of Norge loam, 1 to 3 percent slopes. Numerous rills occur. About 30 percent of this unit has slopes of 2 to 3 percent, and the rest has slopes of 3 to 5 percent.

Included with this eroded Norge loam in mapping were areas of Norge loam, 1 to 3 percent slopes, that make up about 5 percent of the mapped acreage and areas of Vanoss loam and of Teller loam that each make up about 4 percent. Also included were small areas of Renfrow silty clay loam.

This eroded loam has lower fertility and is more difficult to till than other Norge loams.

Most of this soil is in native range. Small grains, sorghums, sericea lespedeza, and grasses can be grown, however, if management is intensive and includes terracing, contour farming, adding fertilizer, growing legumes, and using crop residue. Small grains can be grown continuously if crop residue is properly used. (Capability unit IIIe-5; Loamy Prairie range site; woodland suitability group 3)

Port Series

In the Port series are deep, nearly level soils that occur on bottom lands along the Deep Fork North Canadian River and along some of the smaller streams. These soils are occasionally to frequently flooded.

In a typical profile the surface layer is reddish-brown, slightly acid loam about 13 inches thick. The next layer is red, neutral loam about 21 inches thick. The underlying material is loamy alluvium that is easily penetrated by roots.

Except for a poorly drained, frequently flooded soil, Port soils are well drained. Port soils have moderate to high available water-capacity and high natural fertility.

Typical profile of Port loam, occasionally flooded, in a cultivated field (about 2,400 feet west and 300 feet north from the southeast corner of the northeast quarter of section 7, T. 15 N., R. 2 E.):

A1—0 to 13 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) when moist; moderate, fine, granular structure; hard when dry; friable when moist, slightly acid; gradual boundary; horizon 6 to 20 inches thick.

AC—13 to 34 inches, red (2.5YR 4/6) heavy loam, dark red (2.5YR 3/6) when moist; weak, fine, granular structure; porous; hard when dry, friable when moist; neutral; gradual boundary; horizon 8 to 30 inches thick.

C—34 to 50 inches +, red (2.5YR 5/6) loam, dark red (2.5YR 3/6) when moist; massive; porous; slightly hard when dry, friable when moist; calcareous.

The A1 horizon is dominantly loam, but in some places it is fine sandy loam or clay loam. Color ranges from brown to dark reddish brown in hue of 5YR to 7.5YR. The AC horizon is stratified, loamy material. Color ranges from reddish brown to yellowish red in hue of 2.5YR and 5YR. The C horizon is neutral to calcareous.

Port soils are less sandy between depths of 10 and 40 inches than are the Yahola or Pulaski soils.

Port clay loam, frequently flooded (0 to 1 percent slopes) (Pf).—This soil borders the Deep Fork North Canadian River and occurs on flood plains of its tributaries. Dry Creek and Quapaw Creek. The profile of this soil is more clayey than that described as typical for the series and is dark reddish brown to a depth of more than 20 inches.

Included with this frequently flooded soil in mapping were areas of a noncalcareous soil that is similar to Yahola clay loam. These included areas make up about 15 percent of the mapped acreage.

Several times a year, when overflow from the river and creeks does not drain properly, this Port clay loam stays wet for long periods. Flooding and saturation worsen year by year.

When this soil is dry enough, its native vegetation is used for forage. During dry years, some areas are sown to small grains and others are seeded to pasture plants. This soil is not suited to cultivated crops. (Capability unit Vw-4; Loamy Bottomland range site; woodland suitability group 2)

Port clay loam, occasionally flooded (0 to 1 percent slopes) (Pc).—This soil occurs with Port loam, occasionally flooded, in some parts of the county, but at slightly lower elevations. In other parts, it occurs in large areas and is dominant on the bottom lands.

The profile of this soil contains more clay than the one described as typical for the series. The surface layer is a reddish-brown clay loam about 10 inches thick. The next layer is much like the surface layer, but it is stratified with sandy or silty material in some places. The underlying material is reddish clay loam.

Included with this soil in the mapping were areas of Port loam, occasionally flooded, that make up about 10 percent of the mapped acreage. Also included, and making up about 3 percent, were areas of Miller clay. Other included areas were of a Port soil that has a silty clay loam surface layer.

Most of this soil is cultivated, mainly to wheat and alfalfa. This soil is well suited to bermudagrass, and large areas of this grass have been grown. Small grains can be grown continuously if crop residue is used effectively. The main needs in managing this soil are practices that maintain soil structure and fertility and that protect the soil from damaging overflow of streams. Also needed are diversion terraces for diverting water that runs off adjacent uplands. (Capability unit IIw-1; Loamy Bottomland range site; woodland suitability group 1)

Port loam, occasionally flooded (0 to 1 percent slopes) (Po).—This soil occurs on bottom lands, generally with Port clay loam, frequently flooded, or Pulaski fine sandy loam. Port loam, occasionally flooded, has the profile described as typical for the Port series (fig. 5).

Included with this soil in mapping were small areas of Pulaski fine sandy loam that make up about 5 percent of the mapped acreage. Also included, and making up about 4 percent, were small areas of Port clay loam, occasionally flooded.

Port loam, occasionally flooded, is easy to till and is well suited to cultivated crops. Wheat is the main crop, though alfalfa, sorghums, and a small but important crop of peanuts are grown. Small grains can be grown continuously if crop residue is properly used. The main needs in managing this soil are practices that maintain soil structure and fertility and that protect the soil from damaging overflow of streams. Also needed are diversion terraces for diverting water that runs off adjacent uplands. (Capability unit IIw-1; Loamy Bottomland range site; woodland suitability group 1)

Figure 5.—**Soil profile of Port loam, occasionally flooded. Plant roots easily penetrate this deep soil.**

Pulaski Series

In the Pulaski series are deep, reddish-brown, nearly level soils in loamy alluvium. In Lincoln County these soils occur along some of the larger streams and along the smaller streams that drain areas of Darnell and Stephenville soils.

In a typical profile the surface layer is reddish-brown, slightly acid fine sandy loam about 16 inches thick. The next layer is red fine sandy loam. It is underlain by red fine sandy loam that is stratified by loamy fine sand.

Pulaski soils are moderately fertile and have moderately rapid permeability. These soils are easy to till. They respond well to use of fertilizer and other management practices.

Typical profile of Pulaski fine sandy loam, in a cultivated field (about 2,200 feet west and 350 feet south of the northeast corner of section 8, T. 14 N., R. 4 E.):

A1—0 to 16 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; slightly acid; gradual, smooth boundary; horizon 10 to 22 inches thick.

AC—16 to 36 inches, red (2.5YR 5/6) fine sandy loam, red (2.5YR 4/6) when moist; moderate, medium, granular structure; soft when dry, very friable when moist; weakly stratified; slightly acid; gradual, smooth boundary; horizon 10 to 30 inches thick.

C—36 to 54 inches +, red (2.5YR 5/8) fine sandy loam stratified with thin layers of loamy fine sand, red (2.5Y 4/8) when moist; nearly structureless; loose when dry or moist; slightly acid.

The A1 horizon of Pulaski soils is generally fine sandy loam, but in about 5 percent of the acreage this horizon is loamy fine sand, and in a few small areas it is loam. Color of the A1 horizon is dominantly reddish brown but ranges from reddish brown through yellowish red to brown in hue of 2.5YR to 7.5YR. Reaction ranges from medium acid to slightly acid. The AC horizon ranges from reddish brown to red. The C horizon is slightly acid to neutral. Below a depth of 40 inches, texture generally ranges from loam to loamy fine sand, but in some places strata of darker, more clayey material occur.

Pulaski soils are more sandy than Port soils and less calcareous than Yahola soils.

Pulaski fine sandy loam (0 to 1 percent slopes) (Ps).—This soil occurs on flood plains along small streams in Lincoln County and occurs with Port soils along larger streams. It has the profile described as typical for the series. Included with this soil in mapping were areas of Port loam, occasionally flooded, that make up about 7 percent of the acreage mapped.

About 70 percent of Pulaski fine sandy loam is cultivated to small grains, alfalfa, grain sorghum, and peanuts. This soil is well suited to those crops. The remaining 30 percent is used for tame pasture and native grasses. Small grains can be grown continuously if crop residue is used effectively and adequate fertilizer is added. The main concerns in managing this soil are maintaining soil structure and fertility and protecting the soil from damage by occasional overflow of streams and from damage by mild soil blowing. (Capability unit IIw–2; Loamy Bottomland range site; woodland suitability group 1)

Pulaski soils, wet (0 to 1 percent slopes) (Pw).—These soils have a profile similar to the one described as typical for the series, but normally they are darker in color. Also, generally there is free water on or within 2 feet of the soil surface. Pulaski soils, wet, occur along small drainageways, mostly in the western one-third of the county. The wet condition is usually caused by clogged stream channels and natural springs that are nearby.

Included with these soils in mapping were areas of Port clay loam, frequently flooded, and of a soil similar to Pulaski soils, wet, but that is calcareous at or near the surface.

Pulaski soils, wet, are not suited to cultivated crops, because these soils are poorly drained and have a high water table at or near the surface for most of the year. Some areas are in tame pasture consisting of bermudagrass, but most areas are too wet and too heavily covered with stands of willow and cottonwood trees. Other areas are covered with switchgrass, wildrye, and sand bluestem and are used for permanent pasture. Excellent tame pasture could be established if the water table were lowered and trees were removed to allow mowing and other practices necessary for effective management of tame pasture. (Capability unit Vw—3; Subirrigated range site; woodland suitability group 2)

Renfrow Series

The Renfrow series consists of deep, very gently sloping and gently sloping soils on prairie uplands. These soils formed from clay and shale of the Permian red beds. They occur in large areas near Meeker and in the northwestern part of the county.

In a typical profile, the surface layer is brown, slightly acid silt loam 9 inches thick. The subsoil extends to a depth of 38 inches. It consists of reddish-brown clay in the upper part and red clay in the lower part. The underlying material is weathered clay and shale.

Renfrow soils are well drained and moderately fertile. Their subsoil is very slowly permeable to roots, air, and water. These soils generally hold a large amount of water, but not enough is available to plants in summer.

Typical profile of Renfrow silt loam, 1 to 3 percent slopes, in a cultivated field (about 1,800 feet east and 650 feet south of the northwest corner of section 15, T. 16 N., R 2 E.):

A1—0 to 9 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary; horizon 6 to 11 inches thick.

B2t—9 to 26 inches, reddish-brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) when moist; weak, medium, blocky structure; very hard when dry, very firm when moist; continuous clay films; neutral; gradual boundary; horizon 10 to 25 inches thick.

B3—26 to 38 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) when moist; weak, medium, blocky structure; very hard when dry, very firm when moist; several pockets of calcium carbonate; several ferromagnesium concretions; calcareous, gradual boundary; horizon 8 to 20 inches thick.

C—38 to 52 inches +, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) when moist; massive; very hard when dry, very firm when moist; calcareous; partly weathered clay beds.

The A1 horizon is loam in some places and typically is silty clay loam in eroded areas. This horizon ranges from brown to dark reddish brown in hue of 10YR to 5YR. The B horizon ranges from red or reddish brown to dark reddish brown. Calcareous material is generally at a depth of more than 24 inches. Depth to the C horizon ranges from 30 to 50 inches.

Renfrow soils contain more clay in the subsoil than Zaneis or Chickasha soils. They are redder than Kirkland soils and deeper than Vernon soils.

Renfrow silt loam, 1 to 3 percent slopes (ReB).—This soil occupies small areas mostly on ridgetops. It has the profile described as typical for the series. Included in mapping were small areas of Kirkland silt loam that make up 25 percent of the mapped areas and of Vernon clay loam that make up 5 percent.

This is one of the more desirable soils of the uplands for growing small grains, mainly winter wheat. Sorghums, legumes, and native grasses are also grown.

Management is needed to control water erosion, conserve moisture, and maintain soil structure. Tillage is difficult on this soil and should be avoided soon after rains. Where row crops are grown, terraces and contour tillage are needed. Small grains can be grown year after year where crop residue is properly used and fertilizer is added. (Capability unit IIIe-1; Claypan Prairie range site; woodland suitability group 3)

Renfrow silt loam, 3 to 5 percent slopes (ReC).—This soil occurs on uplands, mainly with other Renfrow soils and Vernon soils. It has a profile similar to the one described as typical for the series, but its subsoil is redder, is not so thick, and contains a dense claypan that is very slowly permeable and is difficult to till. Included in mapping were small areas of Vernon clay loam and Zaneis loam.

This soil is desirable for growing small grains, mainly winter wheat. Sorghums, legumes, and native grasses also are grown, but they are not well suited, mainly because this soil is somewhat droughty in summer.

Management is needed for controlling water erosion and maintaining fertility and soil structure. Terraces and contour tillage are needed to control erosion. Small grains can be grown year after year if crop residue is returned to the soil and enough fertilizer is added to insure good growth of crops. (Capability unit IVe-5; Claypan Prairie range site; woodland suitability group 3)

Renfrow silty clay loam, 2 to 5 percent slopes, eroded (RfC2).—This soil occurs on the upper parts of small eroded drainageways and on uniformly convex slopes. It has a profile similar to the one described as typical for the series. The surface layer, however, is generally only 4 to 8 inches thick, and in about 35 percent of the acreage the plow layer is a mixture of surface layer and subsoil. This soil is subject to water erosion. It takes in water very slowly, is droughty, and is difficult to till.

Included in mapping were small areas of Vernon clay loam, Chickasha loam, Bonham loam, and Zaneis loam.

About 40 percent of this soil is idle cropland, about 25 percent is in small grains, and the remaining 35 percent is in native range and tame pasture. Row crops generally are not suited. Small grains and sorghums can be grown, but grasses are better suited. Where this soil is cultivated, terraces, contour tillage, and additions of fertilizer are needed. (Capability unit IVe-2; Claypan Prairie range site; and woodland suitability group 4)

Renfrow-Vernon complex, 2 to 5 percent slopes, severely eroded (RvC3).—This mapping unit is in the prairie, mainly in the western part of the county. Renfrow and Vernon soils, in about equal amounts, occupy about 60 percent of this complex. Each kind of soil has a profile similar to the one described as typical for its respective series, except that its surface layer is thinner. In about 20 percent of the complex are soils that are similar to Renfrow soils but that have had their dark loam surface layer removed by erosion. Most of the remaining 20 percent consists of soils similar to typical Vernon soils, except that they are deeper to partly weathered clay beds. Also in the complex are small areas of eroded Chickasha and Bonham soils and small areas of eroded, closely intermingled Darnell and Stephenville soils.

Gullies that cannot be crossed by farm machinery occur at intervals of 200 to 500 feet in 75 to 85 percent of this complex. Between the gullies much of the surface layer has been removed by sheet erosion.

This complex is so severely eroded that it is not suitable for cultivation. These soils should be returned to permanent vegetation. The plants are difficult to establish because the surface layer is clayey. The present cover consists mainly of three-awn, grama, splitbeard bluestem, and silver bluestem. (Capability unit VIe-1; Eroded Clay range site; woodland suitability group 4)

Roebuck Series

In the Roebuck series are poorly drained, deep, clayey soils. These soils occur on bottom lands along the Deep Fork North Canadian River, mostly between Warwick and Sparks. Roebuck soils are frequently flooded, and they stay wet for long periods.

In a typical profile reddish-brown clay extends from the surface to a depth of 50 inches. The material is mildly alkaline to a depth of 25 inches and is calcareous below that depth.

Roebuck soils are very slowly permeable, and during wet seasons water stands on the surface for many weeks. These soils are fertile, however, and crops can be grown where the soils are adequately drained and protected from damaging overflow of streams. But in most places draining and protecting the soils from flooding is not practical.

Typical profile of Roebuck clay in native range (about 3,500 feet west and 150 feet south of the northeast corner of section 30, T. 14 N., R. 4 E.):

A1—0 to 15 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) when moist; weak, medium, subangular blocky structure; very hard when dry, firm when moist; noncalcareous; mildly alkaline; gradual boundary; horizon 8 to 20 inches thick.

AC—15 to 25 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) when moist; massive; very hard when dry, very firm when moist; noncalcareous; mildly alkaline; gradual boundary; horizon 10 to 20 inches thick.

C—25 to 50 inches, reddish-brown (2.5YR 4/4) clay, dark red (2.5YR 3/6) when moist; massive; very hard when dry, very firm when moist; calcareous.

The color throughout all horizons ranges from dark reddish brown to red in hue of 2.5YR to 5YR. Texture of all horizons is generally clay, but there are strata of more loamy material in some places. The content of clay is between 50 and 65 percent. In some places mottles occur below a depth of 15 inches. Some areas have recent deposits of loamy material on the surface.

Roebuck soils are more poorly drained than Miller or Lela soils and are redder than Lela soils.

Roebuck clay (0 to 1 percent slopes) (Rx).—This poorly drained soil occurs on bottom lands and is frequently flooded. A few areas are 100 acres or more in size.

Included with this soil in mapping were areas of Wet alluvial land that make up about 6 percent of the mapped acreage. Also included were small areas of Miller clay.

Many areas of Roebuck clay have been cultivated, but now only a few areas are. Most of this soil is used for native range and wildlife habitat. The present vegetation is dominantly water weeds, but switchgrass grows well in the more loamy areas. In some areas winter grass is abundant. Because this soil is clayey, has poor surface drainage, and is susceptible to flooding, it has little value for farming. (Capability unit Vw-1; Heavy Bottomland range site; woodland suitability group 4)

Stephenville Series

The Stephenville series consists of moderately deep to deep, loamy soils that formed from weathered sandstone (fig. 6). These soils are very gently sloping and gently sloping where they occur on ridgetops. They are also intermingled closely with Darnell soils throughout the timbered uplands, and in these areas they are generally strongly sloping.

Figure 6.—Profile of Stephenville fine sandy loam showing the underlying sandstone.

In a typical profile the surface layer is brown, medium acid fine sandy loam about 6 inches thick. The next layer is light-brown, medium acid fine sandy loam about 8 inches thick. The subsoil is permeable, yellowish-red sandy clay loam that extends to a depth of about 31 inches. It is underlain by medium acid, weathered sandstone.

Stephenville soils are well drained and have moderate water-holding capacity. They are moderate to low in natural fertility and are susceptible to water erosion and soil blowing if tilled.

Typical profile of Stephenville fine sandy loam, 1 to 3 percent slopes, in virgin timber that has been sprayed (about 110 feet north and 2,500 feet east of the southwest corner of section 32, T. 13 N., R. 3 E.):

A1—0 to 6 inches, brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist; medium acid; clear boundary; horizon 3 to 8 inches thick.

A2—6 to 14 inches, light-brown (7.5YR 6/4) light fine sandy loam, dark brown (7.5YR 4/4) when moist; massive; loose when dry, very friable when moist; medium acid; clear, smooth boundary; horizon 6 to 10 inches thick.

B21t—14 to 18 inches, yellowish-red (5YR 5/6) light sandy clay loam, yellowish red (5YR 4/6) when moist;

prominent clay films on ped faces, and bridges on sand grains; weak, medium and fine, subangular blocky structure; slightly acid; gradual, smooth boundary; horizon 3 to 10 inches thick.

B22t—18 to 27 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; prominent but patchy clay films on ped faces, and bridges on sand grains; moderate, medium, subangular blocky structure; hard when dry, firm when moist; medium acid; gradual, smooth boundary; horizon 6 to 12 inches thick.

B3—27 to 31 inches, yellowish-red (5YR 5/8) light sandy clay loam, yellowish red (5YR 4/8) when moist; weak clay films on ped faces, and bridges on sand grains; weak, fine, subangular blocky structure; hard when dry, friable when moist; few sandstone fragments; medium acid; clear, smooth boundary; horizon 0 to 8 inches thick.

R—31 to 40 inches +, red (2.5YR 4/6) weathered sandstone that is easily broken when moist.

The A horizon is dominantly fine sandy loam, but in some places it is loamy fine sand. Color ranges from very pale brown to dark grayish brown. Color of the B horizon ranges from yellowish red to red. Depth to sandstone ranges from 20 to 48 inches but normally is about 31 inches. Reaction throughout the profile ranges from slightly acid to medium acid.

The Stephenville soils are somewhat similar to the Darnell and Konawa soils, but depth to sandstone is less than 20 inches in the Darnell soils and is more than 48 inches in the Konawa soils. In the Stephenville soils, depth to sandstone is more than 20 inches but less than 48 inches.

Stephenville fine sandy loam, 1 to 3 percent slopes (StB).—This very gently sloping soil occurs on ridges and is generally surrounded by more sloping Stephenville soils and shallow to very shallow Darnell soils. This Stephenville soil has the profile described as typical for the series. Included with this soil in mapping were small areas of Darnell and Noble soils.

This Stephenville soil is easily eroded and low in fertility. It is used for native wooded range, cultivated crops, and bermudagrass pasture. Suitable crops are peanuts, cotton, sorghums, and small grains grown with vetch and grasses. If row crops are grown, terraces and contour farming are needed. Crop residue is used to control water erosion and soil blowing (fig. 7). Also needed are additions of fertilizer. (Capability unit IIe-2; Sandy Savannah range site; woodland suitability group 2)

Figure 7.—Management of crop residue on Stephenville fine sandy loam, 1 to 3 percent slopes, helps to provide adequate protection from soil blowing and water erosion during winter.

Stephenville fine sandy loam, 3 to 5 percent slopes (StC).—This deep, excessively drained soil occurs on uplands. Its surface layer is slightly thinner and its subsoil is redder, but otherwise this soil has a profile similar to the one described as typical for the series.

Included with this soil in mapping were small areas of Darnell soils and of Noble soils that together make up about 10 percent of the mapped acreage. Also included were very small areas of a soil that has a subsoil more clayey than that of this Stephenville soil. These included areas are in narrow bands and make up less than 2 percent of the mapped acreage.

Most of this soil has not been cleared and is used for grazing. Many areas are thickly covered with blackjack oak and post oak, but these areas could be cleared to allow better growth of native grasses. In cleared areas, however, invading oaks are troublesome.

Because natural fertility is low and susceptibility to erosion is high, careful management is needed where this soil is used for cultivated crops. Tame pasture, small grains, cotton, and sorghums are commonly grown, but row crops should not be grown for more than 3 consecutive years. Small grains can be grown continuously if fertilizer is added and crop residue is used effectively. Terraces and contour farming should be used with most cropping systems. (Capability unit IIIe-3; Sandy Savannah range site; woodland suitability group 2)

Stephenville fine sandy loam, 2 to 5 percent slopes, eroded (StC2).—This eroded soil occurs on uplands and is moderately deep, rilled, and somewhat gullied. Continuous cultivation has contributed to the loss of soil through erosion. In most places 40 to 75 percent of the surface layer has been removed by erosion, and this layer is 2 to 6 inches thinner than the one in the profile described as typical for the series. The plow layer is generally a mixture of fine sandy loam from the original surface layer and sandy clay loam from the subsoil. The present plow layer contains more clay than the original surface layer. In about 35 percent of the acreage of this soil the slopes are 2 to 3 percent, and in the remaining 65 percent slopes are 3 to 5 percent. Depth to sandstone averages about 25 inches.

Included with this eroded soil in mapping were areas of Stephenville fine sandy loam that are not more than slightly eroded. These areas make up about 45 percent of the mapped acreage. Also included were small areas of a soil that is less than 20 inches deep to sandstone.

Nearly all of this soil has been cultivated at one time. Now, however, about 50 percent is used as native range, though the range is in poor condition. About 20 percent consists of abandoned fields in which undesirable grasses and weeds have invaded. The remaining 30 percent is used for bermudagrass, rye and vetch, grain sorghum, and small grains.

Where this soil is cultivated, terraces, contour tillage, and crops that produce large amounts of residue are helpful in reducing erosion and conserving water. An example of a suitable cropping system would be continuous small grain and vetch with additions of fertilizer and use of crop residue. (Capability unit IIIe-6; Sandy Savannah range site; woodland suitability group 3)

Teller Series

In the Teller series are deep, loamy, very gently sloping to gently sloping soils of the upland prairie. These soils normally are a few miles from major streams or rivers and in many places are adjacent to the bottom lands. Teller soils formed in old, deep, loamy soil material.

In a typical profile, the surface layer is brown loam about 10 inches thick. The subsoil extends to a depth of 48 inches and is loam that grades to clay loam at a depth of 18 inches. Color ranges from reddish brown to yellowish red to red. The subsoil is underlain by red loam. The profile throughout is neutral.

Teller soils are well drained to somewhat excessively drained. They are moderately fertile, are moderately permeable to air and water, and can be penetrated by roots.

Typical profile of Teller loam, 3 to 5 percent slopes, in a native grass range (about 2,400 feet east and 100 feet south of the northwest corner of section 24, T. 17 N., R. 2 E.):

A1—0 to 10 inches, brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; neutral; gradual boundary; horizon 8 to 12 inches thick.

B1—10 to 18 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; neutral; gradual boundary; horizon 6 to 10 inches thick.

B2t—18 to 36 inches, yellowish-red (5YR 5/6) light clay loam, yellowish red (5YR 4/6) when moist; moderate, medium, subangular blocky structure; clay films on ped faces; slightly hard when dry, friable when moist; neutral; gradual, smooth boundary; horizon 14 to 22 inches thick.

B3—36 to 48 inches, red (2.5YR 5/6) light clay loam, red (2.5YR 4/6) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; porous; neutral; gradual, smooth boundary; horizon 8 to 18 inches thick.

C—48 to 56 inches +, red (2.5YR 4/8) heavy loam, dark red (2.5YR 3/6) when moist; massive; porous; slightly hard when dry, very friable when moist; neutral.

The A1 horizon is loam in most places, but in some places it is silt loam. Color ranges from brown to dark reddish brown. The B horizon ranges from loam to light clay loam in texture and is red, reddish brown, or yellowish red in hue of 2.5YR or 5YR. The C horizon is loam and is easily penetrated by roots. Reaction throughout the profile ranges from slightly acid to neutral.

Teller soils are more loamy than Dougherty or Konawa soils. The subsoil of Teller soils is less clayey than that of Norge soils and is redder and less silty than that of Vanoss soils.

Teller loam, 1 to 3 percent slopes (TeB).—This deep soil occurs on uplands in areas of less than 40 acres. It has a reddish-brown surface layer that is slightly acid instead of neutral and is thicker than the surface layer in the profile described as typical for the series. The subsoil is slightly acid, red loam, and it overlies neutral, red loam.

Included with this Teller soil in mapping were areas of Konawa loamy fine sand that make up about 5 percent of the mapped acreage. Also included, in the northwestern part of the county, were small areas of Vanoss and of Norge soils.

This Teller soil is desirable for farming. About 50 percent is cultivated, mainly to small grains and peanuts,

but sorghums, cotton, and grasses are also grown. The remaining 50 percent is in tame pasture or is used for native range. This soil is well drained and has good water-holding capacity, but it is susceptible to water erosion and soil blowing. Small grains can be grown continuously, however, if stubble mulching is used effectively and adequate fertilizer is added. Terraces and contour farming are needed if row crops are planted. (Capability unit IIe-1; Loamy Prairie range site; woodland suitability group 2)

Teller loam, 3 to 5 percent slopes (TeC).—This soil is on uplands within a few miles of major rivers and of Quapaw Creek. Its profile is the one described as typical for the series. It occurs closely with the Norge, Vanoss, and Konawa soils and on the same kind of landscape.

Included with this Teller loam in mapping were areas of Zaneis loam that make up about 7 percent of the mapped acreage, of Dougherty loamy fine sand that make up about 5 percent, and of Norge loam that make up about 3 percent. Also included were small areas of Teller loam, 2 to 5 percent slopes, eroded.

Most areas of Teller loam, 3 to 5 percent slopes, are used as native range, but in these areas brush control and effective grazing patterns are needed. The soil is well suited to crops, but it is susceptible to severe water erosion if cultivated and not protected. Most crops common in the county, such as winter wheat, sorghums, and legumes and grasses, can be grown if management is good. Terraces, contour farming, and use of crop residue are needed in reducing erosion, in conserving moisture, and in maintaining soil structure. Small grains can be grown year after year if crop residue is used effectively and adequate fertilizer is added. (Capability unit IIIe-2; Loamy Prairie range site; woodland suitability group 2)

Teller loam, 2 to 5 percent slopes, eroded (TeC2).—This eroded soil occurs where water concentrates on uplands near major streams or rivers and in many places is adjacent to less eroded Teller soils. The surface layer is generally redder and is at least 3 inches thinner than the surface layer in the profile described as typical for the series. In most areas, 30 to 60 percent of the surface layer has been removed by erosion. The plow layer is dominantly a mixture of the original surface layer and the red clay loam subsoil. In a few places all of the surface layer has been removed and the subsoil is exposed. Below a depth of 30 inches, the subsoil grades to loam. Rills are numerous.

Included with this eroded Teller loam in mapping were small areas of Zaneis loam, of Norge loam, and of Konawa loamy fine sand. Also included were areas of a Teller soil that has a fine sandy loam surface layer containing small rounded pebbles of quartz.

At one time all of this soil was farmed, but now only 40 percent is in cultivated crops. Small grains and sown sorghums are the main crops grown. Some areas used as tame pasture are seeded to sericea lespedeza and grasses. The remaining areas are used as native range.

In managing this soil, protection of cultivated areas from severe rill and gully erosion is needed. Intensive management, through use of terraces, of contour farming, of crop residue, and additions of fertilizer, is needed to improve suitability of this soil for cultivation and to insure good growth of crops. Row crops should not be planted. Reseeding to native grasses and deferred grazing are needed to improve the native range forage. (Capability unit IIIe-5; Loamy Prairie range site; woodland suitability group 3)

Vanoss Series

In the Vanoss series are deep, dark, loamy soils that are nearly level to very gently sloping. These soils occur as small areas on uplands in widely separated parts of Lincoln County. They formed from deep, loamy sediment under tall grasses and trees.

In a typical profile the surface layer is slightly acid, brown loam about 16 inches thick. The subsoil extends to a depth of 52 inches or more. It is silty clay loam that is brown to a depth of 40 inches and yellowish red below that depth. This soil material can be penetrated for many feet by roots.

Vanoss soils are well drained and fertile. They are moderately permeable to air, water, and roots. Their water-holding capacity is moderately high. These soils are easy to till.

Typical profile of Vanoss loam, 0 to 1 percent slopes, in a cultivated field (about 1,325 feet east and 150 feet south of the northwest corner of section 20, T. 17 N., R. 2 E.):

Ap—0 to 7 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; slightly acid; plowed boundary; horizon 4 to 9 inches thick.

A3—7 to 16 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) when moist; moderate, medium, granular structure; hard when dry, friable when moist; slightly acid; diffuse, smooth boundary; horizon 6 to 12 inches thick.

B21t—16 to 30 inches, brown (7.5YR 5/4) light silty clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium, subangular blocky structure; clay films on ped faces; hard when dry; firm when moist; slightly acid; diffuse, smooth boundary; horizon 8 to 18 inches thick.

B22t—30 to 40 inches, brown (7.5YR 5/4) light silty clay loam, dark brown (7.5YR 3/4) when moist; moderate, medium, subangular blocky structure; patchy clay films on ped faces; hard when dry, firm when moist; slightly acid; diffuse, smooth boundary; horizon 8 to 16 inches thick.

B3—40 to 52 inches +, yellowish-red (5YR 5/6) light silty clay loam, yellowish red (5YR 4/6) when moist; weak, coarse, subangular blocky structure; hard when dry, friable when moist; slightly acid.

The A horizon is dominantly loam but is silt loam in some places. It is 12 to 18 inches thick in noneroded areas. Color of the A horizon is brown and dark brown in hue of 10YR or 7.5YR. The B2t horizon ranges from light silty clay loam to light clay loam. It is brown or yellowish brown in most places and in a few places is mottled with redder shades in the lower part. Reaction throughout the profile ranges from slightly acid to neutral.

Vanoss soils occur closely with the redder Teller and Norge soils. Vanoss soils are more silty and less sandy than Chickasha soils and, unlike those soils, are not underlain by sandstone within a depth of 48 inches.

Vanoss loam, 0 to 1 percent slopes (VaA).—This soil occurs in small areas on uplands. Its profile is the one described as typical for the series. Included with this soil in mapping were small areas of Konawa loamy fine sand, of Norge loam, and of Teller loam.

Vanoss loam is well suited to all crops grown in the county. Suitable crops are small grains, sorghums, alfalfa, peanuts, and tame pasture. Fertility and soil structure can be maintained by seeding legumes, adding fertilizer, and effectively using crop residue. Small grains can be grown year after year if crop residue is used effectively and fertilizer is added. Grain sorghum or another row crop can be planted for 2 consecutive years if the crop is followed by alfalfa or small grain. (Capability unit I–2; Loamy Prairie range site; woodland suitability group 2)

Vanoss loam, 1 to 3 percent slopes (VaB).—This soil occurs in small areas on uplands. Its surface layer is thinner and its subsoil is yellowish at a depth of about 28 inches, but its profile is otherwise similar to the one described as typical for the series.

Included with this soil in mapping were areas of Chickasha loam that make up about 6 percent of the mapped acreage, of Konawa loamy fine sand that make up about 4 percent, and of Norge loam that make up about 3 percent.

This soil is easy to till and is well suited to all crops grown in the county. Suitable crops are small grains, sorghums, alfalfa, and tame pasture. Although this soil is well drained, has moderately high fertility, and has good water-holding capacity, practices are needed for controlling water erosion, reducing water loss, and maintaining soil structure. Small grains can be grown year after year where stubble mulching is used effectively and fertilizer is added. Terraces and contour farming are needed if row crops are planted. (Capability unit IIe–1; Loamy Prairie range site; woodland suitability group 2)

Vanoss loam, 1 to 3 percent slopes, eroded (VaB2).—This eroded soil occurs closely with noneroded Vanoss soils on uplands. From 30 to 70 percent of the loam surface layer has been removed by erosion, and the surface layer is 7 to 11 inches thinner than the one in the profile described as typical for the series. The plow layer is generally a mixture of the original loam surface layer and the yellowish-brown silty clay loam subsoil. In a few places, all of the surface layer has been removed by runoff and the subsoil exposed. Numerous small rills are common.

Included with this eroded Vanoss loam in mapping were small areas of Chickasha loam, of Norge loam, and of Konawa fine sandy loam. Also included were areas of a Vanoss soil that has a fine sandy loam surface layer.

Only about 30 percent of this Vanoss loam is cultivated, and that mostly to small grains. Fifty percent formerly was cultivated but is now in weeds and grasses of low quality. These areas are used for forage, or they lie idle. The remaining 20 percent is in improved tame pasture.

Vanoss loam, 1 to 3 percent slopes, eroded, has lower fertility and is more difficult to till than Vanoss soils that are only slightly eroded. This soil is suitable for cultivation, however, if erosion is controlled and soil structure is improved through intensive management. Wheat or other small grains grow well year after year where crop residue is used effectively and adequate fertilizer is added. Terraces and contour farming are helpful in reducing soil loss. Row crops seldom should be planted. (Capability unit IIIe–5; Loamy Prairie range site; woodland suitability group 3)

Vernon Series

The Vernon series consists of reddish, gently sloping to moderately steep soils that have a calcareous, clayey subsoil. These soils are shallow to beds of weathered clay. They formed under short, mid, and tall grasses.

In a typical profile the surface layer is reddish-brown clay loam about 5 inches thick. It is difficult to till. The subsoil is calcareous, reddish-brown clay that extends to a depth of 14 inches. It is underlain by beds of red and gray weathered clay.

Vernon soils are somewhat excessively drained and moderately fertile. They have very slow permeability and low to medium capacity to hold available water. These soils erode quickly where tilled. Most areas are in native range.

Typical profile of Vernon clay loam, 3 to 5 percent slopes, in native range (about 2,000 feet north and 75 feet west of the southeast corner of section 30, T. 12 N., R. 4 E.):

A1—0 to 5 inches, reddish-brown (2.5YR 4/4) clay loam, dark reddish brown (2.5YR 3/4) when moist; strong, medium, granular structure; hard when dry, firm when moist; mildly alkaline; clear, smooth boundary; horizon 3 to 8 inches thick.

B—5 to 14 inches, reddish-brown (2.5YR 4/4) clay, dark red (2.5YR 3/6) when moist; moderate, medium, blocky structure; very hard when dry, very firm when moist; calcareous; calcium carbonate concretions; clear, smooth boundary; horizon 6 to 15 inches thick.

C—14 to 18 inches +, beds of red and gray weathered clay; massive; calcareous.

The A1 horizon is clay loam in most places, but in some places it is silty clay loam, and in a few places it is clay. Color ranges from brown to red in hue of 2.5YR to 7.5YR. The B horizon is clay in most places, but in some places it is heavy silty clay loam. Reddish clay is dominant in the C horizon, but thin gray strata are present.

Vernon clay loam, 3 to 5 percent slopes (VcC).—This soil generally occurs in areas of less than 30 acres and is scattered throughout the county on prairies. It has the profile described as typical for the series. Included in mapping were areas of Lucien loam that make up about 10 percent of the mapped acreage, and of Renfrow silt loam that make up about 5 percent.

About 85 percent of this soil is in native range consisting dominantly of side-oats grama, blue grama, and little bluestem. Suitable grazing practices and reseeding of formerly cultivated fields are needed for best use of these range areas.

The remaining 15 percent is cultivated to small grains that are sown in fall. This soil, however, is not well suited to cultivated crops, because it is shallow to clay, has very slow permeability, is moderately susceptible to water erosion, and is difficult to till. Small grains can be grown year after year only if management is intensive and provides terraces and contour farming, effective use of crop residue, and additions of fertilizer. (Capability unit IVe–1; Red Clay Prairie range site; woodland suitability group 4)

Vernon-Collinsville complex, 5 to 20 percent slopes (VeF).—This complex consists of Vernon and Collinsville soils in intricate patterns so intermingled that it is impractical to map each kind of soil separately. These soils are shallow or very shallow and occur in the more sloping, more broken areas of the prairie landscape in the

northeastern part of the county. The materials from which these soils formed are interbedded clay, shale, and sandstone. In most places, the Vernon soil is underlain by clay and the Collinsville soil by sandstone.

The Vernon soil makes up about 65 percent of this complex; the Collinsville soil, about 25 percent; and a very shallow soil over limestone, the remaining 10 percent. Included with these soils on the more sloping breaks parts of the prairie landscape were areas of exposed clay, shale, sandstone, or limestone.

Except that Vernon soil in this complex is calcareous from the surface, it has a profile similar to the one described as typical for the Vernon series. The Collinsville part of the complex has the profile described as typical for the Collinsville series. The very shallow soil included in the mapping unit is dark silt loam that extends to a depth of 7 inches and is underlain by limestone.

This complex is used for native range. The dominant grasses are little bluestem, side-oats grama, and blue grama, but indiangrass and switchgrass grow in less abundance in the loamy areas. The quality of the native grasses can be maintained or improved by controlling brush and using suitable grazing practices. Because the soils of this complex are shallow or very shallow and are sloping to moderately steep, they are not suitable for cultivation. (Both soils are in capability unit VIIs-1; Vernon soil is in the Red Clay Prairie range site, and the Collinsville soil is in the Shallow Prairie range site; both soils are in woodland suitability group 4)

Vernon-Lucien complex, 5 to 15 percent slopes (VlE).—This complex is made up of Vernon and Lucien soils that are so intermingled that it is impractical to map each kind of soil separately. The largest acreage of these shallow soils occurs in the rougher, more broken parts of the prairie landscapes in the western two-thirds of the county.

The Vernon soil makes up about 65 percent of the acreage mapped, and the Lucien soil makes up about 25 percent. Included with these soils in mapping were small areas of Zaneis and Renfrow soils that together make up about 10 percent. Also included, on short, moderately steep slopes, were a few areas of exposed clay, shale, or sandstone.

Except that the surface layer is darker and the subsoil and underlying material are red, the Vernon soil in this complex has a profile similar to the one described as typical for the Vernon series. The Lucien part of the complex has the profile described as typical for the Lucien series.

All of this complex is used for native grass range. Little bluestem, side-oats grama, and blue grama are dominant, and indiangrass and switchgrass grow in the more loamy areas. The quality of the native grasses can be maintained or improved by controlling brush and regulating the grazing. Because the soils of this complex are shallow or very shallow and are sloping to moderately steep, they are not suitable for cultivation. (Both soils are in capability unit VIe-4; Vernon soil is in Red Clay Prairie range site, and Lucien soil is in Shallow Prairie range site; both soils are in woodland suitability group 4)

Wet Alluvial Land

Wet alluvial land (0 to 1 percent slopes) (We) occurs mainly along the Deep Fork North Canadian River and at the lower parts of its tributaries in the eastern half of Lincoln County. About 50 years ago, a channel through the bottom lands along the river was improved. Now, however, the channel is so filled with soil material, and with logs and other debris, that adjacent areas are frequently flooded and remain under water for several weeks each year. Watermarks on trees in these areas are at heights between 3 and 5 feet. In about 75 percent of this land, the water table is at a depth of less than 4 feet when water is not standing on the surface. In some areas hummocks and swales occur, and in other places the land is nearly level and has shallow surface drains.

The soil materials vary in texture and in places are stratified with clayey, loamy, or sandy alluvial materials. Normally, the hummocks are sandy, the swales are clayey, and the level areas are loamy or clayey. The sandy and loamy materials are red to reddish yellow, and the clayey materials are red to reddish brown. The soil materials throughout are medium acid or calcareous.

Vegetation consists dominantly of willow, cottonwood, and elm trees. In the less shaded areas there is a sparse understory of johnsongrass and tall native grasses. All areas are used as wildlife habitat and, when not flooded, for limited grazing. Because of the frequent flooding and the high water table, these soils are not suitable for cultivation. (Capability unit VIIw-1; Wetlands range site; woodland suitability group 3)

Yahola Series

In the Yahola series are deep, dark, loamy soils that are calcareous. These soils are occasionally flooded to frequently flooded. They occur on bottom lands along the Deep Fork North Canadian River, the North Canadian River, and along some of the smaller streams.

In a typical profile the surface layer is reddish-brown clay loam about 10 inches thick. The next layer is 22 inches thick and consists of red fine sandy loam that is stratified by loamy fine sand and fine sand. The underlying material is stratified red loamy fine sand that is easily penetrated by roots. The profile is calcareous throughout.

Yahola soils are moderately fertile, and their permeability is moderately rapid. Some areas of these soils have a water table at a depth of less than 5 feet. Other areas are slightly droughty in dry periods.

Typical profile of Yahola clay loam in a cultivated field (about 2,200 feet north and 150 feet east of the southwest corner of section 14, T. 14 N., R. 3 E.):

A1—0 to 10 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; weak, fine, subangular blocky structure; hard when dry, firm when moist; calcareous; gradual, smooth boundary; horizon 6 to 16 inches thick.

AC—10 to 32 inches, red (2.5YR 4/6) fine sandy loam, dark red (2.5YR 3/6) when moist; weak, medium, granular structure to massive; hard when dry, friable when moist; stratified with loamy fine sand and fine sand; calcareous; gradual, smooth boundary; horizon 15 to 30 inches thick.

C—32 to 52 inches +, red (2.5YR 5/6) loamy fine sand, dark red (2.5YR 4/6) when moist; single grain; slightly hard when dry, very friable when moist; stratified; calcareous.

In most places the A1 horizon is clay loam, but in a few places it ranges from fine sandy loam to light clay. It generally is calcareous but is alkaline in some places. Color ranges from yellowish red to dark brown. The AC horizon is slightly lighter colored than the A1 horizon. The AC horizon is stratified in most places. The strata are generally fine sandy loam, but they range from fine sand to clay loam. The C horizon is loamy fine sand that contains thin strata of loamy material.

Yahola soils are more sandy in the layer beneath the surface layer and in the C horizon than are those layers in Port soils. Yahola soils are more alkaline than Pulaski soils.

Yahola clay loam (0 to 1 percent slopes) (Yc).—This deep, reddish-brown, loamy soil is calcareous and alluvial. It occurs on bottom lands and normally is flooded each year. Its profile is the one described as typical for the series.

Included with this soil in mapping were areas of Port clay loam that make up about 8 percent of the acreage mapped. Also included were areas that have a water table within 50 inches of its surface and that commonly are marked by a scattering of small, light-colored slick-spots containing salt accumulations. These included areas make up less than 5 percent of the acreage mapped.

Nearly all of this soil is cultivated, though tillage is moderately difficult. Alfalfa and small grains are the main crops, but all crops commonly grown are suited. Small grains can be grown continuously if crop residue is used effectively. Practices are needed for maintaining soil structure and fertility, for protecting the soil from damaging overflow of streams, and for lowering the water table in some areas. Also needed in some areas are diversion terraces for carrying away runoff from adjacent areas. (Capability unit IIw–1; Loamy Bottomland range site; woodland suitability group 1)

Yahola fine sandy loam (0 to 1 percent slopes) (Yf).—This soil occurs on bottom lands in places where flooding is likely at least once a year. About half of the acreage is along the Deep Fork North Canadian River in areas that are protected by levees. Floodwater sometimes breaks through these levees and deposits damaging silt.

The surface layer of this soil is yellowish-red, calcareous fine sandy loam about 16 inches thick. The underlying material is red, calcareous fine sandy loam that is highly stratified.

Included with this soil in mapping were areas of Port loam and Pulaski fine sandy loam. Each of these soils makes up about 6 percent of the mapped acreage. Also included were areas that have a water table at a depth of about 50 inches and, near the North Canadian River, of a soil that has a brown to dark-brown surface layer over pale brown to very pale brown lower layers.

About two-thirds of Yahola fine sandy loam is cultivated to small grains, corn, grain sorghum, peanuts, and alfalfa. Most of the rest is in bermudagrass, which grows well in some of the frequently flooded, silted areas. A small acreage is in native grass range. If crop residue is used effectively and adequate fertilizer is added, small grains can be grown year after year on this soil. The main concerns in managing this soil are controlling erosion, reducing soil blowing, and maintaining fertility and soil structure. (Capability unit IIw–2; Loamy Bottomland range site; woodland suitability group 1)

Zaneis Series

The Zaneis series consists of deep to moderately deep, loamy soils that are gently sloping. The largest areas of these soils occur on upland prairies north and west of Carney. Zaneis soils formed from weathered sandstone or sandy shale.

In a typical profile the surface layer is brown loam about 9 inches thick. The subsoil extends to a depth of 44 inches and consists of clay loam that is reddish brown in the upper part and yellowish red in the lower part. The underlying material is red, weathered, sandy shale that extends to a depth of 56 inches or more. The soil material is slightly acid to a depth of 17 inches and is neutral below that depth.

Zaneis soils are moderately high in fertility and are moderately easy to till. They are well drained and have moderately slow permeability. Water-holding capacity is moderately high. Water erosion is a moderate hazard in cultivated areas.

Typical profile of Zaneis loam, 3 to 5 percent slopes, in a native grass pasture (about 600 feet north and 2,300 feet east of the southwest corner of section 20, T. 17 N., R. 2 E.):

A1—0 to 9 inches, brown (7.5YR 4/3) loam, dark brown (7.5YR 3/3) when moist; moderate, medium, granular structure; slightly hard when dry, very friable when moist; slightly acid; gradual, smooth boundary; horizon 6 to 12 inches thick.

B1—9 to 17 inches, reddish-brown (5YR 4/4) light clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium granular structure; hard when dry, friable when moist; slightly acid; gradual, smooth boundary; horizon 4 to 12 inches thick.

B2t—17 to 32 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, subangular blocky structure; patchy clay films on ped faces; hard when dry, firm when moist; neutral; gradual, smooth boundary; horizon 12 to 26 inches thick.

B3—32 to 44 inches, yellowish-red (5YR 5/8) light clay loam, yellowish red (5YR 4/8) when moist; common, fine, faint, reddish-brown mottles; weak, fine, subangular blocky structure; hard when dry, firm when moist; few black concretions; neutral; clear boundary; horizon 6 to 14 inches thick.

C—44 to 56 inches +, red (2.5YR 4/6), weathered, sandy shale; light gray (10YR 7/2) when moist; neutral.

In most places the A1 horizon is loam, but in some places it is silt loam. Color ranges from brown to dark reddish brown. The B horizon is clay loam in most places but is silty clay loam in other places. The B2t horizon ranges from yellowish red to dark reddish brown. The C horizon is weathered and ranges from fine-grained sandstone to sandy shale. Depth to bedrock ranges from 24 to about 60 inches.

Zaneis soils have a subsoil that is less clayey than that of Renfrow soils and is redder than the subsoil of Chickasha soils. Sandstone or shale is within a depth of 60 inches in the Zaneis soils, but not in the Norge or Teller soils.

Zaneis loam, 3 to 5 percent slopes (ZaC).—The largest areas of this soil occur on uplands in the northwestern part of the county. The profile of this soil is the one described as typical for the series.

Included with this soil in mapping were areas of Chickasha loam that make up about 6 percent of the acreage mapped. Also included were areas of Renfrow silt loam, of Norge loam, and of eroded Zaneis loam.

Zaneis loam, 3 to 5 percent slopes, is mostly in native range, but a few areas are cultivated to small grains and sorghums. Most crops common in the county can be grown. Small grains can be grown year after year if fertilizer is added and crop residue is used effectively. Because this soil is susceptible to water erosion, terraces and contour farming are needed. (Capability unit IIIe-2; Loamy Prairie range site; woodland suitability group 2)

Zaneis loam, 3 to 5 percent slopes, eroded (ZaC2).—This soil occurs on uplands in the Carney area of the county. It has a surface layer that generally is only 5 inches thick and is thinner than the surface layer in the profile described as typical for the Zaneis series. In about 30 to 50 percent of the acreage, the surface layer has been mixed with the upper part of the subsoil and is more clayey than it is in less eroded areas.

Included with this soil in mapping were areas of Zaneis loam, 3 to 5 percent slopes, that make up about 10 percent of the acreage mapped. Also included were areas of Chickasha loam that make up about 6 percent, or Renfrow silty clay loam that make up about 3 percent, and of Norge loam that make up about 1 percent.

Most of this soil is used for native range that has low carrying capacity. A small part is in bermudagrass, and a few areas are used for small grains, sorghums, and sericea lespedeza. Required in cultivated areas is intensive management for controlling erosion and maintaining soil structure. Small grains can be grown continuously if fertilizer is added and crop residue is used effectively. Row crops should not be grown. Terraces and contour farming are essential. The range could be improved by sowing native grasses, deferring grazing, and stocking properly. (Capability unit IIIe-5; Loamy Prairie range site; woodland suitability group 3)

Use and Management of the Soils

The soils of Lincoln County are used mainly for crops that support the raising of livestock and for native grass range and tame pasture. This section tells how the soils can be used for those main purposes, and also for woodland, for wildlife, and in building roads, farm ponds, and other engineering structures.

Soil Management and Predicted Yields

First described in the following pages are general guidelines for managing soils used for tilled crops and tame pasture. Then, predicted yields of crops are listed, and the system of capability classification used by the Soil Conservation Service is explained. Those who wish to know the capability classification of a soil can refer to the "Guide to Mapping Units" at the back of this survey. Those desiring detailed information about the management of the soils can turn to the section "Descriptions of the Soils."

Managing soils for tilled crops and tame pasture [2]

The main crops grown on the soils of Lincoln County are wheat, barley, rye, oats, and sorghums. Alfalfa, corn, and soybeans are grown to a lesser extent on Port clay loam; on Port loam, occasionally flooded; and on the deep, nearly level Vanoss soils of the uplands.

On the soils used for crops in this county, management is needed for controlling erosion, maintaining the supply of organic matter, improving or maintaining tilth, and conserving moisture. In some places surface crusting also requires attention.

Suitable practices for helping to control erosion in the county are growing a winter cover crop; stripcropping; growing grasses, legumes, or both, in a long-term conservation cropping system with tilled crops; constructing terraces; farming on the contour; grassing of waterways; and applying lime and fertilizer where needed.

The content of organic matter in the Stephenville, Teller, Zaneis, and other soils of the uplands has decreased so much that practices must be used so as to improve and maintain tilth. In recent years increased surface crusting and excessive tillage have emphasized the need for better management on all arable soils. Other local concerns are related to the high water table of Pulaski soils, wet, and to the flooding of Port, Yahola, and Pulaski soils. To help prevent soil blowing on the sandy Dougherty and Eufaula soils, overgrazing should be prevented and plant residue should be used for protection.

The increase in crop yields in recent years indicates that better plant varieties have been used and that fertilizer has been added. The fertility and physical condition of the Zaneis, Chickasha, Mason, and Vanoss soils decline when crops are grown on these soils year after year. Small grains or other nonleguminous crops that produce a large amount of residue can be used to maintain or improve suitability of these soils for crops. If small grains are grown and the straw is left as residue, it frequently is necessary to add nitrogen that hastens the decomposition of the straw. The practice, however, is not a substitute for adding nitrogen for better growth of crops.

Tame pasture occupies a large acreage in Lincoln County. Bermudagrass is the most important warm-season grass grown on the arable soils, such as the Bonham and the Stephenville. Weeping lovegrass and other grasses are also used extensively for tame pasture. Pasture on the Norge, Chickasha, and similar soils may be overseeded with big hop clover, Ladino clover, hairy vetch, and other legumes. A suitable mixture for tame pasture is 60 to 80 percent grasses and 40 to 20 percent legumes. Growth of forage can be maintained by timely additions of fertilizers.

Tall fescue and smooth bromegrass are perennial cool-season grasses that are suited to Port soils on bottom lands. Fescue also grows well on the somewhat poorly drained Miller soils.

Fertilizer is generally needed for establishing a stand of perennial pasture plants. Soil deficiencies can be determined by soil tests. Then a fertilizer program can be used that is suited to the pasture plants and that gives the

[2] M. D. GAMBLE, conservation agronomist, Soil Conservation Service, assisted in the preparation of this section.

level of production desired. Proper grazing and necessary brush and weed control insure good growth for a long period.

Predicted yields

Table 4 shows predicted average yields of important crops and of tame pasture. The crops are wheat, oats, barley, grain sorghum, alfalfa, cotton, and peanuts. Yields are given for two levels of management. The predictions are averages for a period long enough to include both dry and wet years. When the moisture supply is favorable, yields are generally higher than those predicted. Yields are lower when moisture is unfavorable. Crop failures were included when the average yields were estimated. The following mapping units that generally are not used for crops or tame pasture are not listed in table 4:

Breaks-Alluvial land complex.
Broken alluvial land.
Darnell-Stephenville fine sandy loams, 3 to 12 percent slopes.
Darnell-Stephenville complex, 3 to 12 percent slopes, severely eroded.
Renfrow-Vernon complex, 2 to 5 percent slopes, severely eroded.
Vernon-Collinsville complex, 5 to 20 percent slopes.
Vernon-Lucien complex, 5 to 15 percent slopes.
Wet alluvial land.

The yields in table 4 are based partly on records kept by the Oklahoma Agricultural Experiment Station on fertility studies, crop variety tests, and crop rotation and tillage trials. These experiments have been conducted for many years on both permanent and experimental sites and on farmers' plots. The records provide an excellent source of information for estimating long-term average yields on a number of soils.

TABLE 4.—*Predicted average acre yields of principal crops and tame pasture under dryland farming*

[Yields in columns A are those obtained under customary management; those in columns B are obtained under improved management. Absence of yield indicates crop is not commonly grown on the soil at the level of management specified]

Soil	Wheat		Oats		Barley		Grain sorghum		Alfalfa		Cotton		Peanuts		Tame pasture			
															Common bermudagrass		Improved bermudagrass	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Lbs. of lint*	*Lbs. of lint*	*Lbs.*	*Lbs.*	*Animal-unit-month* [1]	*Animal-unit-month* [1]	*Animal-unit-month* [1]	*Animal-unit-month* [1]
Bonham loam, 1 to 3 percent slopes	18	28	30	40	30	40	28	38	1. 6	2. 6	275	375	720	1, 320	3. 4	5. 2	5. 0	6. 5
Bonham loam, 3 to 5 percent percent slopes	16	26	28	38	28	38	26	36	----	----	----	----	----	------	3. 2	4. 5	4. 4	6. 0
Bonham loam, 2 to 5 percent slopes, eroded	12	17	22	30	22	30	----	----	----	----	----	----	----	------	2. 6	4. 0	3. 0	5. 0
Chickasha loam, 1 to 3 percent slopes	16	24	26	36	25	35	24	35	1. 4	2. 2	230	330	720	1, 320	3. 2	4. 8	4. 6	6. 5
Chickasha loam, 3 to 5 percent slopes	14	22	24	34	22	32	20	33	----	----	----	----	----	------	3. 0	4 5	3. 8	6. 0
Chickasha loam, 2 to 5 percent slopes, eroded	10	14	18	28	16	27	----	----	----	----	----	----	----	------	2. 5	3. 6	3. 0	4. 5
Chickasha and Bonham soils, 2 to 6 percent slopes, severely eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	------	1. 5	3. 5	------	------
Crevasse loamy fine sand	7	15	22	25	21	24	18	32	----	----	----	----	----	------	2. 5	4. 0	3. 5	5. 0
Dale silt loam	22	32	35	55	36	55	35	50	3. 0	4. 2	400	500	800	1, 440	5. 0	7. 0	6. 2	8. 0
Dougherty loamy fine sand, 3 to 8 percent slopes	9	14	23	30	23	31	----	----	----	----	----	----	----	------	2. 5	4. 5	3. 5	5. 8
Eufaula-Dougherty complex, 5 to 12 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	------	1. 5	3. 5	------	------
Kirkland silt loam, 0 to 1 percent slopes	14	22	30	45	27	40	20	35	----	----	250	350	----	------	2. 4	3. 2	2. 4	4. 0
Konawa loamy fine sand, 0 to 3 percent slopes	10	16	26	35	26	35	22	30	----	----	150	275	500	1, 020	3. 0	5. 0	4. 0	6. 3
Konawa loamy fine sand, 3 to 8 percent slopes, severely eroded	----	----	----	----	----	----	----	----	----	----	----	----	----	------	1. 5	3. 5	------	------
Lela clay	12	20	20	40	20	33	28	41	----	----	225	400	----	------	3. 2	4. 5	3. 8	5. 5
Mason silt loam	20	30	32	48	32	44	32	48	2. 5	4. 0	275	450	780	1, 320	5. 0	7. 0	6. 0	8. 0
Miller clay	13	20	20	40	23	36	30	47	----	----	225	400	----	------	3. 5	5. 0	4. 0	6. 0
Noble fine sandy loam, 3 to 8 percent slopes	10	16	24	30	23	31	----	----	----	----	----	----	----	------	3. 4	4. 5	4. 0	6. 0

See footnote at end of table.

TABLE 4.—*Predicted average acre yields of principal crops and tame pasture under dryland farming*—Continued

Soil	Wheat		Oats		Barley		Grain sorghum		Alfalfa		Cotton		Peanuts		Tame pasture: Common bermudagrass		Tame pasture: Improved bermudagrass	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Lbs. of lint*	*Lbs. of lint*	*Lbs.*	*Lbs.*	*Animal-unit-month* [1]	*Animal-unit-month* [1]	*Animal-unit-month* [1]	*Animal-unit-month* [1]
Norge loam, 1 to 3 percent slopes	16	28	30	42	30	40	30	44	2. 0	2. 8	250	375	720	1, 320	3. 8	5. 8	5. 5	7. 5
Norge loam, 3 to 5 percent slopes	14	23	26	36	26	36									3. 4	4. 5	4. 5	6. 5
Norge loam, 2 to 5 percent slopes, eroded	12	18	22	30	20	30									3. 0	4. 0	3. 5	5. 0
Port clay loam, occasionally flooded	22	32	40	55	36	50	40	55	3. 0	4. 4	350	500			5. 0	7. 0	6. 0	8. 0
Port clay loam, frequently flooded															4. 5	6. 5	5. 5	7. 5
Port loam, occasionally flooded	22	32	40	55	36	50	40	55	3. 0	4. 4	350	500	720	1, 440	5. 0	7. 0	6. 0	8. 0
Pulaski fine sandy loam	14	22	25	35	25	35	30	40	1. 8	3. 2	250	375	810	1, 440	4. 8	6. 2	6. 0	8. 0
Pulaski soils, wet															3. 0	5. 0	4. 5	6. 0
Renfrow silt loam, 1 to 3 percent slopes	14	20	22	33	20	32	18	26			190	260			2. 0	3. 5		
Renfrow silt loam, 3 to 5 percent slopes	12	18	20	30	17	30									1. 5	3. 0		
Renfrow silty clay loam, 2 to 5 percent slopes, eroded	10	15	16	26	14	24												
Roebuck clay															3. 5	4. 5		
Stephenville fine sandy loam, 1 to 3 percent slopes	12	18	25	35	25	35	22	32	1. 4	2. 1	200	300	600	1, 200	2. 8	5. 0	3. 5	6. 0
Stephenville fine sandy loam, 3 to 5 percent slopes	10	16	22	30	22	30	20	28			150	250	480	900	2. 4	4. 5	3. 2	5. 6
Stephenville fine sandy loam, 2 to 5 percent slopes, eroded	7	14	14	23											2. 0	3. 5	3. 0	4. 5
Teller loam, 1 to 3 percent slopes	17	24	27	38	26	36	25	36	2. 0	2. 6	180	340	720	1, 350	3. 8	5. 6	5. 0	7. 0
Teller loam, 3 to 5 percent slopes	14	22	25	35	24	35	22	35							3. 4	4. 5	4. 5	6. 5
Teller loam, 2 to 5 percent slopes, eroded	12	18	18	28	16	27									3. 0	4. 0	3. 5	5. 0
Vanoss loam, 0 to 1 percent slopes	20	30	32	43	32	43	32	48	2. 2	3. 4	275	425	810	1, 500	4. 0	6. 0	6. 0	8. 0
Vanoss loam, 1 to 3 percent slopes	18	28	30	42	30	40	30	44	2. 0	3. 2	250	400	750	1, 400	3. 8	5. 8	5. 5	7. 5
Vanoss loam, 1 to 3 percent slopes, eroded	16	23	26	36	26	36	25	36							3. 5	5. 0	5. 0	6. 5
Vernon clay loam, 3 to 5 percent slopes	10	14	16	25	14	23												
Yahola clay loam	17	25	25	40	25	40	35	45	2. 5	3. 5	350	500			4. 8	6. 2	6. 0	8. 0
Yahola fine sandy loam	15	22	25	35	25	35	30	38	1. 8	3. 2	250	375	720	1, 440	4. 8	6. 2	6. 0	8. 0
Zaneis loam, 3 to 5 percent slopes	14	22	24	34	22	32	20	33							3. 0	4. 5	3. 8	6. 0
Zaneis loam, 3 to 5 percent slopes, eroded	10	14	18	28	16	27									2. 5	3. 6	3. 0	4. 5

[1] Animal-unit-months are the number of months during a year that 1 acre will provide grazing for 1 animal, or 1,000 pounds of live weight; or it is the number of months times the number of animal units. For example, Dale silt loam in a pasture of improved bermudagrass under improved management will provide grazing for 4 animals for 2 months and is rated 8 animal-unit-months.

The soil scientists who made this survey obtained other data on yields at specifiic levels of management when they interviewed farmers and observed fields of crops. If enough data for a certain soil were not obtained, estimates were made by comparing the yields on that soil with those on similar soils for which ample data were available.

The yields shown in columns A are those that can be expected under common management, or management practiced by a substantial number of farmers in the county. Common management normally provides (1) proper rates of seeding, timely dates of planting, and efficient methods of harvesting; (2) sufficient control of weeds, insects, and plant diseases to insure plant growth; (3) use of terraces and contour farming where needed; (4) small applications of lime and fertilizer on fields used for cash crops and where legumes are to be established; (5) widespread use of the moldboard plow and one-way disk plow.

The yields in columns B can be expected under improved management. Improved management includes the first four practices listed for common management plus (1) application of lime and fertilizer in amounts indicated by soil tests, or suggested by local agricultural technicians; (2) use of adapted improved varieties of crops; (3) use of cover crops on sandy soils that tend to blow; (4) installation of surface drains where needed; and (5) management of crop residue and tillage so as to control erosion, maintain soil structure, increase infiltration of water, and assist the emergence of seedlings.

331-682—69——3

Capability classification

In the "Guide to Mapping Units" at the back of this survey, the soils of Lincoln County have been classified according to their suitability for most kinds of farming. The capability classification of a soil is also listed at the end of the description of each mapping unit in the section "Descriptions of the Soils."

Capability classification is based on limitations of the soils, the risk of damage when they are used, and the way in which they respond to treatment. The classification does not apply to most horticultural crops, or to rice and other crops having special requirements. The soils are classified according to degree and kinds of permanent limitation, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible major reclamation.

In this system all soils are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability Classes, the broadest grouping, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. Classes are defined as follows:

Class I. Soils have few limitations that restrict their use.

Class II, Soils have some limitations that reduce the choice of plants or require moderate conservation practices.

Class III. Soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV. Soils have very severe limitations that restrict the choice of plants, require very careful management, or both.

Class V. Soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Class VII. Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Class VIII. Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to purposes for improving the landscape esthetically. (None in Lincoln County.)

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, but not in Lincoln County, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only subclasses indicated by *w*, *s*, and *c*, because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Use of Soils For Range [3]

Range is land on which the vegetation is mainly native grasses, forbs, and shrubs in sufficient quantity and of the quality to justify grazing. In Lincoln County range consists of native grasslands and oak savannahs.

About 71 percent of Lincoln County is used as range. The deeper, smoother, less sloping soils have been plowed and used for crops, but the more shallow of the steep and stony soils are in native pastures. Many fields are abandoned cropland that has returned naturally to tall native grasses.

Much of the range is in small livestock farms, and there are a few large ranches. The major livestock enterprise is raising beef and selling weaner calves.

Rangelands are usually grazed all year, but livestock are also fed protein supplements and hay in the winter. Tame pastures are used to complete the yearlong grazing.

Lincoln County has about 443,460 acres of range. Of this acreage about 156,379 acres supports varying amounts of scrubby post oak and blackjack oak.

Native grass hay is harvested from about 10,700 acres annually. These hay meadows are normally on the deeper soils, such as Bonham and Chickasha loams. Where abundant, the aftermath is grazed during the period when grasses are dormant.

Range sites and condition classes

A range site is a distinctive kind of rangeland that is sufficiently uniform in climate, soil, and elevation to produce a particular kind of climax vegetation. In the same pasture area, there may be several range sites, each of which require different stocking rates and different management practices. These practices include fencing,

[3] By Henry Neal Stidham, range conservationist, Soil Conservation Service.

locating places for salting and watering, determining the period of grazing, deciding on the number and kind of livestock, and controlling brush.

The soils on any one range site produce the same climax vegetation. Climax vegetation is the combination of plants that originally grew on the site. It is generally the most productive vegetation for the site, and it will maintain itself under conditions similar to those that existed before the site was cultivated or heavily grazed.

On the sites where grazing is intense, important changes in kinds and amount of vegetation take place. Continuous excessive grazing alters the original plant cover and lowers productivity. The livestock seek out the more palatable and nutritious grasses, and under heavy grazing, these choice plants, or *decreasers*, are weakened and gradually eliminated. The choice plants are replaced by less palatable plants, or *increasers*. If heavy grazing continues, even these increasers are weakened and the site is eventually occupied by less desirable grasses and weeds, which are called *invaders*.

The downward trend in range vegetation is generally continuous under heavy grazing and can be expressed as range condition. Four classes of range condition are recognized. Range is in *excellent* condition if 76 to 100 percent of the plant cover consists of the original vegetation. It is in *good* condition if the percentage is 51 to 75; in *fair* condition if the percentage is 26 to 50; and in *poor* condition if the percentage is 25 or less. If range is in poor condition, most of the vegetation is made up of weak increasers and invaders.

One of the main objectives of good range management is to keep the range in excellent condition or at least in good condition. When this is done, moisture is conserved, yields are maintained or improved, and the soils are protected from deterioration. A major problem is being able to interpret the meaning of changes in kind of cover. The changes may be so gradual that they are overlooked or are misinterpreted. Heavy rainfall following a period of droughty or of close grazing encourages a denser cover. This increased plant growth leads to the belief that the range is in good condition or is at least improving. The cover, however, may be weedy, and the longtime trend is toward poor range condition. On the other hand, rangeland in excellent condition may appear to be in poor condition because it has been heavily grazed for a short period. Under good moisture conditions and proper stocking rates, this range quickly recovers its vigorous growth of grasses.

Descriptions of range sites

The soils of Lincoln County have been grouped into 16 range sites according to their ability to produce similar kinds and amounts of climax vegetation. The description of each range site gives the more important characteristics of the soils and the names of the principal plants. Also given is the estimated total annual yield of herbage on the site in excellent condition when moisture is favorable and when it is unfavorable. These estimates are based on the annual growth of plants. The plants were clipped at ground level near the end of the growing season and air dried. The yields given represent the total production of the site and should not be interpreted as representing only usable or grazable forage. Those given for Savannah sites, however, are for grasses and forbs and do not include leaves, stems, or fruit of woody plants.

To find the names of the soils in any unit, refer to the "Guide to Mapping Units" at the back of this survey.

CLAYPAN PRAIRIE RANGE SITE

The soils of this site have a clay subsoil that restricts the penetration of water and the growth of plants. Range plants, however, grow moderately well.

Where this site is in excellent condition, decreasers make up 60 percent of the plant mixture. The decreasers are little bluestem, switchgrass, indiangrass, purpletop, ashy sunflower, and tall gayfeather. Increasers make up the other 40 percent. They are meadow dropseed, Scribner panicum, blue grama, and goldenrod. Under prolonged heavy grazing, invaders are abundant. Among the invaders are buffalograss, three-awn, western ragweed, common broomweed, bitterweed, and hawthorn bushes.

Where this site is in excellent condition, the estimated annual yields of air-dry herbage is about 4,000 pounds per acre in years of favorable moisture and about 2,000 pounds per acre in years of unfavorable moisture.

ERODED CLAY RANGE SITE

Only Renfrow-Vernon complex, 2 to 5 percent slopes, severely eroded, is in this range site. The soils in this complex were formerly cultivated, but erosion has removed most of the surface layer, and the clayey subsoil is exposed in many areas. Because the water-holding capacity is limited, reestablishing vegetation is difficult. In recent years, however, some natural revegetation has occurred. When this site returns to good condition, the better grasses are little bluestem, indiangrass, switchgrass, and perennial three-awn.

Range plants similar to those on the Claypan Prairie site grow on this site, but not so well as they do on the Claypan Prairie site. Common invaders are silver bluestem, tumblegrass, splitbeard bluestem, and annual three-awn.

After several years of good growth and favorable moisture, the estimated annual yield of air-dry herbage is about 1,400 pounds per acre; but after several years of unfavorable moisture, the yield is only about 800 pounds per acre.

ERODED PRAIRIE RANGE SITE

Only Chickasha and Bonham soils, 2 to 6 percent slopes, severely eroded, are in this range site. Severe sheet erosion and, in many places, gully erosion have removed most of the surface layer of these soils and have made the surface subject to severe crusting. This crusting limits the intake of moisture and the growth of plants.

Indiangrass, big bluestem, little bluestem, and other tall grasses can grow on this site, but only about half as well as on the Loamy Prairie site.

Where this site is in excellent condition, the estimated annual production of air-dry herbage is about 3,000 pounds per acre in years of favorable moisture and about 1,500 pounds per acre in years of unfavorable moisture.

LOAMY PRAIRIE RANGE SITE

This site consists of nearly level to moderately steep loamy soils. Except in a few shallow areas, these soils are

moderately deep to deep and generally have moisture content favorable for growth of tall grasses.

Forage plants grow better on this range site than on the other range sites in the uplands. Where the site is in excellent condition, about 80 percent of the vegetation consists of a mixture of big bluestem, little bluestem, indiangrass, and switchgrass, which are decreasers. About 15 percent consists of increasers. Among the increasers are tall dropseed, purpletop, jointtail, wild alfalfa, wild indigo, goldenrod, and heath aster. Legumes and forbs make up the remaining 5 percent. Sumacs are common woody increasers. Legumes and forbs on this site include tickclover, prairie clover, leadplant, and gayfeathers. Common invaders are broomsedge, splitbeard bluestem, three-awns, showy partridgepea, western ragweed, common broomweed, elm, persimmon, and hawthorn.

When the site is in excellent condition (fig. 8), the estimated annual yield of air-dry herbage is about 5,000 pounds per acre in years of favorable moisture and about 2,500 pounds per acre in years of unfavorable moisture.

RED CLAY PRAIRIE RANGE SITE

This range site consists of gently sloping to moderately steep clayey soils. These soils absorb water moderately well if the surface is protected by a heavy mulch of grass. Careful management of grazing is needed if the grasses are to grow moderately well (fig. 9).

Little bluestem is the main decreaser on this site. The main increasers are side-oats grama, blue grama, and buffalograss, and there are small amounts of meadow dropseed, Scribner panicum, hairy grama, and tall grama. If the site is in poor condition, important invaders are common broomweed, western ragweed, croton, tumblegrass, and annual three-awn.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is about 2,700 pounds per acre in years of favorable moisture and about 1,600 pounds per acre in years of unfavorable moisture.

SHALLOW PRAIRIE RANGE SITE

This range site consists of sloping to moderately steep loamy soils on hills and ridges (fig. 10). These soils are

Figure 8.—Loamy Prairie range site in excellent condition. The soils are Bonham loams.

shallow over sandstone or shale, and in many areas sandstone is at or near the surface.

Where this site is in excellent condition, decreasers make up about 70 percent of the climax vegetation and increasers make up about 30 percent. The main decreasers are little bluestem, big bluestem, indiangrass, wildrye, tall dropseed, catclaw sensitivebrier, and Maximilian sunflower. Important increasers are side-oats grama, meadow dropseed, hairy grama, and silver bluestem. Winged elm, hawthorn, and persimmon come in with the increasers. Common invaders are annual bromes, three-awns, splitbeard bluestem, broomsedge, ragweed, and common broomweeds.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is about 4,800 pounds per acre in years of favorable moisture and about 2,400 pounds per acre in years of unfavorable moisture.

DEEP SAND SAVANNAH RANGE SITE

This range site consists of deep sands that are on uplands and are nearly level to strongly sloping. These soils support oak trees and a mixture of tall grasses.

Where this site is in excellent condition, 75 percent of the vegetation consists of a mixture of grasses and forbs and about 25 percent is woody species. Of the 75 percent, decreasers make up 55 percent and increasers make up 20 percent. Among the decreasers are little bluestem, big bluestem, indiangrass, switchgrass, and beaked panicum. Increasers include purpletop, tall dropseed, Scribner panicum, sand lovegrass, and Texas bullnettle. Invaders are broomsedge, splitbeard bluestem, annual three-awn, ragweed, horseweed fleabane, showy partridgepea, and white snakeroot.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is about 4,000 pounds per acre in years of favorable moisture and about 2,000 pounds per acre in years of unfavorable moisture.

ERODED SANDY SAVANNAH RANGE SITE

Only the Stephenville soil of Darnell-Stephenville complex, 3 to 12 percent slopes, severely eroded, is in this range site. This soil is moderately deep to partly wea-

***Figure 9.*—The grasses on this Vernon soil in the Red Clay Prairie range site are definitely improving. After the soil was out of cultivation for several years, the owner seeded indiangrass, little bluestem, and switchgrass. Six years later the highly productive grasses are making seed, increasing in growth, improving in composition, and advancing control of erosion.**

331-682—69——4

Figure 10.—**An area of Collinsville soils in the Shallow Prairie range site in excellent *condition.* Little bluestem, big bluestem, indiangrass, and other tall grasses grow on this site. The trees are persimmon and hawthorn.**

thered sandstone. Most of the soil was formerly cultivated and should be seeded to tall native grasses. The grasses generally do not grow well, because the soil is gullied and has limited intake and storage of moisture.

The same mixture of grasses can grow on this site as on the Sandy Savannah site, but not so well. The decreaser grasses are little bluestem, indiangrass, and switchgrass, and increasers are Scribner panicum, purpletop, and goldenrod. Common invaders are broomsedge, splitbeard bluestem, three-awns, and ragweeds.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is about 2,500 pounds per acre in years of favorable moisture and about 1,000 pounds per acre in years of unfavorable moisture.

ERODED SHALLOW SAVANNAH RANGE SITE

Only the Darnell soil of Darnell-Stephenville complex, 3 to 12 percent slopes, severely eroded, is in this range site. This shallow to very shallow soil was formerly cultivated. The underlying sandstone is exposed in many areas.

This site can support vegetation similar to that on the Shallow Savannah site, but in less quantity. Among these plants are little bluestem, indiangrass, splitbeard bluestem, broomsedge, three-awns, and ragweeds. Trees that return to abandoned fields are post oak, blackjack oak, persimmon, and winged elm.

Where this site is in excellent condition, the estimated annual yield in air-dry herbage is about 1,700 pounds per acre in years of favorable moisture and about 1,000 pounds per acre in years of unfavorable moisture.

SANDY SAVANNAH RANGE SITE

This range site consists of very gently sloping to strongly sloping fine sandy loams. These soils support a mixture of tall grasses and woody plants.

Where this site is in excellent condition, about 80 percent of the plant cover consists of grasses and forbs and about 20 percent consists of post oak and blackjack oak. The main decreasers are big bluestem, little bluestem, and indiangrass. Increaser grasses and forbs are Scribner panicum, purpletop, goldenrods, asters, and pe-

Figure 11.—**An area of Darnell soils in the Shallow Savannah range site in excellent condition. The post oak was sprayed with a herbicide, and grazing was deferred during the summer.**

rennial sunflower. Where this site is in poor condition, the plant cover deteriorates to an almost pure stand of post oak and blackjack oak sprouts and a very weak stand of decreaser grasses.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is about 4,500 pounds per acre in years of favorable moisture and about 2,500 pounds per acre in years of unfavorable moisture.

SHALLOW SAVANNAH RANGE SITE

Only the Darnell soil of Darnell-Stephenville fine sandy loams, 3 to 12 percent slopes, is in this range site (fig. 11). This soil is on ridges, and it has horizontal beds of sandstone near the surface. It is droughty and supports only a limited number of desirable plants.

Post oak, blackjack oak, and a few hickory trees grow in open stands where this site is in excellent condition. These trees make up about 25 percent of the plant composition, and grasses, legumes, and forbs make up about 75 percent. The main grasses are little bluestem, indiangrass, switchgrass, side-oats grama, and big bluestem. If the condition of this site declines to poor, the grasses thin out and are replaced by oak sprouts and weeds. The site then appears to be woodland consisting of post oak and blackjack oak sprouts.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is about 3,200 pounds per acre in years of favorable moisture and about 1,400 pounds per acre in years of unfavorable moisture.

HEAVY BOTTOMLAND RANGE SITE

In this range site are deep, level, somewhat poorly drained clays on bottom lands. These soils are waterlogged during rainy periods but are droughty during dry years.

Many of the climax plants on this site grow during cool seasons when woody species are dormant and sunshine reaches the grasses. Where this site is in excellent condition, decreasers are switchgrass, prairie cordgrass, big bluestem, Florida paspalum, wildryes, broadleaf uniola, sedges, and rushes. Grasses, legumes, and forbs make up about 65 percent of the plant cover when the range is in excellent condition, and American elm, pecan, walnut, indigobush, and other woody plants make up the

rest. Plants in abundance where the site is in poor condition are seacoast sumpweed, buffalograss, meadow dropseed, ragweeds, hawthorn, peppervine, and trumpet-creeper.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is about 5,500 pounds per acre in years of favorable moisture and about 2,500 pounds per acre in years of unfavorable moisture.

LOAMY BOTTOMLAND RANGE SITE

This site consists of deep, fertile, loamy soils on bottom lands. Because these soils have the ability to store large amounts of moisture for plants, this site has the highest potential for production in the county.

If this site is in excellent condition, it supports a mixture of tall grasses, trees, and other woody plants. Among the tall grasses are eastern gamagrass, prairie cordgrass, big bluestem, switchgrass, broadleaf uniola, and wildryes. The woody plants include walnut, pecan, indigobush, and trumpetcreeper. Also, American elm, green ash, black walnut, and red oak are adapted to this site. Grasses and forbs make up about 55 percent of the cover, and woody plants make up the rest.

Where this site is in poor condition, the plant cover consists mainly of saw greenbriar, hawthorn, post and blackjack oaks, pecan sprouts, elms, sumpweed, ironweed, ragweeds, broomsedge, and johnsongrass.

Where this site is in excellent condition, the estimated yield of annual air-dry herbage is about 8,500 pounds per acre in years of favorable moisture and 4,500 pounds per acre in years of unfavorable moisture.

SANDY BOTTOMLAND RANGE SITE

Only Crevasse loamy fine sand is in this range site. This deep soil is on bottom lands and is subject to occasional or frequent flooding. In some areas in low swales the soil is subirrigated.

Except in places where hummocks and deep sandy deposits hinder growth, plants grow fairly well on this soil. It has the ability to retain a favorable amount of moisture for plant use and is readily penetrated by roots.

Grasses common on this site are switchgrass, little bluestem, indiangrass, and big bluestem. Trees are cottonwood, salt-cedar, and willow. Johnsongrass and bermudagrass are the most common invader grasses.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is about 3,800 pounds per acre in years of favorable moisture and about 2,000 pounds per acre in years of unfavorable moisture.

SUBIRRIGATED RANGE SITE

Only Pulaski soils, wet, are in this range site. These soils have a high water table and are frequently flooded. The extra moisture generally encourages growth of grasses, but in some places this growth is reduced by too much moisture and by shade from trees.

The main forage plants are lowland switchgrass, indiangrass, common reedgrass, and American bulrush. Trees include cottonwood and black willow.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is about 8,000 pounds per acre in years of favorable moisture and about 6,000 pounds per acre in years of unfavorable moisture.

WETLAND RANGE SITE

Only Wet alluvial land is in this range site. It occurs along the Deep Fork North Canadian River where the channel is choked with deposits of variable soil material. This land is intermittently covered with water throughout the year, and in some places it is under water longer than it is dry. Fencing, therefore, is impractical on much of the site.

Trees are dominant on this site, and grasses, mainly lowland switchgrass, grow sparsely on the higher areas. The trees are elm, willow, hackberry, red oak, pecan, and cottonwood.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is about 2,000 pounds per acre in years of favorable moisture and about 1,000 pounds per acre in years of unfavorable moisture.

Management of Soils for Windbreaks and Post Lots [4]

In Lincoln County most native trees grow along the Deep Fork North Canadian River and the lower reaches of its tributaries. Some of the deep sands and rough, rocky areas of the uplands support trees, but in almost all places these trees are culls or are scrubby. Areas of this kind are called savannahs.

The native woodlands have deteriorated in the county because of the cutting of all merchantable trees, annual or periodic burning, damaging grazing, and general neglect. The clearing of the bottom-land timber has decreased the acreage in woodland, but such clearing is a good practice where the soils are suitable for tame pasture or for cultivated crops. The suitability of soils for pasture or crops should be considered in determining land use.

Native trees of possible value for planting in windbreaks include bur oak, red oak, pin oak, water oak, Osage-orange, American elm, cottonwood, sycamore, ash, black walnut, and eastern redcedar.

Windbreaks and post lots

The most useful trees and shrubs in Lincoln County are those planted in windbreaks. Windbreaks are needed because trees are not plentiful in the county, the wind is sometimes strong, and the temperature may be extreme. Trees are also planted in post lots in the county.

Farmstead windbreaks protect buildings, feedlots, driveways, and other areas around farm buildings, such as orchards and gardens. These windbreaks contribute to human comfort, reduce heating bills, save livestock feed, and control drifting snow.

In Lincoln County there is little need for field windbreaks. A quick crop of quality trees is desired from post lot plantings, but fewer kinds of soils in the county are suitable for post lots than for farmstead windbreaks. Except for Osage-orange, posts cut from native trees in Lincoln County generally are not durable.

Descriptions of woodland suitability groups

The soils of Lincoln County have been placed in four woodland suitability groups according to soil properties

[4] By CHARLES C. BURKE, woodland conservationist, Soil Conservation Service.

that affect the growth of trees. All the soils in a group have about the same capacity for supporting trees. In the descriptions of these groups, the mention of the soil series does not mean that all the soils in the series are in the group. The soils in a group can be determined by referring to the "Guide to Mapping Units" at the back of this survey.

WOODLAND SUITABILITY GROUP 1

The soils in this group are deep, nearly level, moderately fertile to very fertile, and loamy to sandy. These soils are the Crevasse, Dale, Mason, Port, Pulaski, and Yahola. They occur on flood plains and high bottoms. These soils are generally well drained, but they have a water table at a depth of 3 to 5 feet in some places.

This group of soils has very good to excellent potential for growing trees. The original cover probably contained trees of good quality that were large enough to have commercial value.

These soils are suitable for planting trees in post lots or in farmstead windbreaks.

Trees suitable for post lots include black locust, catalpa, red mulberry, and Osage-orange.

Trees suitable for farmstead windbreaks include cottonwood, sycamore, American elm, Siberian elm, pecan, ash, white mulberry, black walnut, and honeylocust. Adapted evergreens are Austrian pine, shortleaf pine, loblolly pine, Arizona cypress (hardy winter variety), and eastern redcedar. For the windward or shrub row, common lilac, American plum, and low-growing varieties of juniper are suitable. Also suitable for the shrub row is Russian mulberry that is severely pruned at the top so that the foliage becomes dense.

WOODLAND SUITABILITY GROUP 2

This group consists of deep, loamy to sandy soils that are level to strongly sloping. These soils are the Bonham, Chickasha, Dougherty, Eufaula, Konawa, Noble, Norge, Port, Pulaski, Stephenville, Teller, Vanoss, and Zaneis. The land type Broken alluvial land is also in this group. The soils in this group occur on bottom lands and uplands and are poorly drained to excessively drained.

Trees grow fairly well on these soils. Cottonwood and sycamore grow well only on the soils of the bottom lands and on the loamy fine sands of the uplands. The suitability of the soils in this group for evergreens generally is about the same as that for the soils in group 1, but redcedar and arborvitae are more likely to survive and to grow more vigorously on the soils in group 2 than are pines.

The trees suitable for planting in windbreaks are about the same as those in group 1 though cottonwood and sycamore should be planted only on Pulaski soils, wet, and Port clay loam, frequently flooded. Loblolly pine should be planted only on the soils of the bottom lands and on the loamy fine sands of the uplands.

WOODLAND SUITABILITY GROUP 3

This group consists of very shallow to deep soils of the bottom lands and uplands. The soils of the bottom lands are nearly level and are somewhat poorly drained. The soils of the uplands are very gently sloping to strongly sloping and loamy to sandy. Drainage ranges from moderately good to excessive, and erosion is slight to severe. The soils in this group are the Bonham, Chickasha, Darnell, Kirkland, Konawa, Lela, Miller, Norge, Renfrow, Stephenville, Teller, Vanoss, and Zaneis. The land type Wet alluvial land also is in this group.

The soils in this group have moderate to severe limitations for growing trees. Osage-orange is the only tree suitable for post lots. It grows fairly well on the Lela and Miller clays, but growth is reduced during droughty periods.

Trees grow in farmstead windbreaks on the soils of this group, but extra care and maintenance are required. The trees, however, do not grow so well as they do on the soils in group 2.

The soils in group 3 are not suited to cottonwood, sycamore, loblolly pine, Arizona cypress, and to common lilac. Only the clay soils are suited to pecan.

WOODLAND SUITABILITY GROUP 4

This group consists of loamy and clayey soils that are very shallow to deep and very gently sloping to moderately steep. The soils are the Collinsville, Lucien, Darnell, Stephenville, Renfrow, Roebuck, and Vernon. The land type Breaks-Alluvial land complex is also in this group. The soils in this group are well drained to excessively drained. Erosion ranges from slight to severe.

These soils are not suited to planted trees, and they do not support any kind of tree that is useful or has commercial value.

Use of Soils for Wildlife [5]

The important kinds of wildlife in Lincoln County are bobwhite quail, mourning dove, fox squirrel, cottontail rabbit, deer, raccoon, mink, opossum, skunk, muskrat, and beaver. Small flocks of wild turkey have been reestablished in the county.

The predators are coyote, bobcat, red fox, and gray fox. Among the predatory birds are several kinds of hawks and owls. Many varieties of songbirds also live in the county, and some waterfowl and shore birds stop during winter migration.

Wildlife suitability groups

The soils of Lincoln County have been placed in wildlife suitability groups according to suitability of the soil as habitat for certain kinds of wildlife. Each of the suitability groups corresponds geographically with one of the four soil associations in the county. These soil associations are shown, in color, on a map at the back of this survey, and they are described in the section "General Soil Map." The wildlife groups are described in the following paragraphs.

WILDLIFE SUITABILITY GROUP 1

This wildlife group consists of the soils in the Port-Pulaski soil association. These soils are on flood plains and are deep, loamy, and level or nearly level. Port and Pulaski soils are dominant, but there are also smaller acreages of the Mason, Miller, Roebuck, Lela, and Yahola soils and of Wet alluvial land.

This wildlife group is well suited to many kinds of wildlife. Trees grow well on all of the soils except the

[5] JEROME SYKORA, biologist, Soil Conservation Service, assisted in writing this subsection.

Miller, Lela, and Roebuck. The trees, and the grass and shrubs among them, provide good habitat for deer, squirrel, turkey, and quail. The habitat is poorly suited to dove.

Pulaski soils, wet, have a high potential for fish pond construction. The water table is easily maintained, and the water is not excessively turbid. The Roebuck soils and Wet alluvial land are moderately suitable for waterfowl. On these soils, however, growth of aquatic plants suitable for waterfowl may be impaired by turbidity and excessive water.

WILDLIFE SUITABILITY GROUP 2

This wildlife group consists of soils in the Darnell-Stephenville association. These soils are very shallow to deep over sandstone. They are loamy, very gently sloping to strongly sloping soils on forested uplands. Darnell and Stephenville soils are dominant, but there are also small areas of Noble, Zaneis, Chickasha, Lucien, Vernon, Renfrow, Konawa, and Pulaski soils.

This wildlife group is poorly to moderately well suited as habitat for deer, turkey, squirrel, and other furbearers. Suitability for wildlife is best in areas adjacent to soil association 1, or soils of the bottom lands. Much of the association is covered with a thick cover of scrub oak that produces little mast. Formerly cultivated soils have grown up in weeds and grasses of poor quality, though these plants provide some food for quail and dove. Lack of cultivated soils lowers the amount of food available for wildlife.

Ponds may be built on all major and minor soils in this wildlife group. Turbidity is not a serious hazard. The number of fish produced can be increased by adding fertilizer to the ponds.

WILDLIFE SUITABILITY GROUP 3

This wildlife suitability group consists of the soils in the Renfrow-Vernon-Bonham soil association. These soils occur on the prairie upland and are very gently sloping to moderately steep. They are loamy soils that are deep to shallow over clay and shale. Also in this group are smaller areas of the Chickasha, Zaneis, Kirkland, Collinsville, Lucien, Port, Pulaski, and Yahola soils.

This wildlife group is moderately well suited as habitat for deer, squirrel, turkey, and for quail and dove. Trees that produce large amounts of mast for squirrel are limited on these soils, but native grasses, shrubs, and small trees suitable for quail are scattered throughout. Plants that improve wildlife habitat are moderately well suited.

In most areas ponds can be constructed, but turbidity in ponds built on the Renfrow and Vernon soils limits production of fish.

WILDLIFE SUITABILITY GROUP 4

In this wildlife suitability group are the soils in the Konawa-Dougherty-Teller association. These soils occur on uplands and are deep, nearly level to strongly sloping, and sandy to loamy. The dominant soils are the Konawa, Dougherty, and Teller, but there are smaller areas of Eufaula, Vanoss, and Norge soils.

The soils of this group support post oak and blackjack oak and an understory of tall native grasses. The most desirable parts of the Konawa and Teller soils are cultivated. Because these cultivated areas are interspersed with native vegetation, this wildlife group is moderately suitable as habitat for quail, squirrel, dove, turkey, and deer. Squirrel are limited by a lack of sufficient mast. Supplemental plantings for wildlife habitat can be made.

The soils normally are too sandy for constructing ponds.

Use of Soils in Engineering[6]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, water storage facilities, erosion control structures, drainage systems, and sewage disposal systems. The properties most important to the engineer are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and reaction. Also important are topography, depth to water table, and depth to bedrock.

Information in the survey can be used to—

1. Make soil and land use studies that will aid in selecting and developing sites for industries, businesses, residences, and recreational areas.
2. Make preliminary estimates of the engineering properties of soils in the planning of agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables and in planning detailed investigations at the selected locations.
4. Locate probable sources of gravel and other construction materials.
5. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining the structure.
6. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps and from reports and aerial photographs for the purposes of making maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes.

With the use of the soil map for identification, the engineering interpretations in this subsection can be useful for many purposes. It should be emphasized, however, that they may not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads or where the excavations are deeper than the depths of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

[6] By WILLIAM E. HARDESTY, civil engineer, Soil Conservation Service.

Much of the information in this subsection is given in tables 5, 6, and 7. In table 5 properties of the soils that are important to engineering are estimated. Table 6 indicates the suitability of the soils for various engineering uses. Table 7 contains test data for soils of six series in the county.

In addition to this subsection, "Descriptions of the Soils," "Formation and Classification of Soils," and other sections of the survey are useful to engineers.

Some of the terms used by the soil scientists may be unfamiliar to engineers, and some terms have a special meaning in soil science. These terms, as well as other terms used in this soil survey, are defined in the Glossary, and some of them are explained in detail in the "Soil Survey Manual" (6).[7]

Engineering classification systems

Two systems of classifying soils are in general use among engineers. One is the system approved by the American Association of State Highway Officials (AASHO) (*1*), and the other is the Unified system adopted by the Corps of Engineers, U.S. Army (*8*). Both systems are used in this survey and are explained in the following paragraphs. The explanations are taken largely from the "PCA Soil Primer" (*3*).

AASHO classification system.—Most highway engineers classify soils according to the AASHO system. In this system, soils are placed in seven principal groups. The groups range from A–1, consisting of gravelly soils of high bearing capacity, to A–7, consisting of clay soils that have low strength when wet. Within each group, the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest. For the soils tested, the group index numbers are shown in table 7 in parentheses following the soil group symbol. The estimated AASHO classification of the soils in the county, without group index number, is given in table 5.

Unified classification system.—In the Unified classification system, the soils are grouped on the basis of their texture and plasticity and their performance as material for engineering structures. Soil material is divided into 15 classes. Eight classes (GW, GP, GM, GC, SW, SP, SM, and SC) are for coarse-grained material; six classes (ML, CL, OL, MH, CH, and OH) are for fine-grained material; and one class (Pt) is for highly organic material. The clean sands are identified by the symbols SW and SP; sands mixed with fines of silt and clay are identified by the symbols SM and SC; silts and clays that have a low liquid limit are identified by the symbols ML and CL; and silts and clays that have a high liquid limit are identified by the symbols MH and OH. The tested soils are classified according to the Unified system in table 7, and the classification for the soils that were not tested is estimated in table 5.

Engineering properties of soils

Table 5 provides estimates of some properties of soils that affect engineering. The estimates are for a modal profile, or a profile typical for the soil series or soil type. For the soils in the county that were tested, estimates in table 5 are based on the test data listed in table 7. For the other soils, estimates are based on test data obtained from similar soils in this county and in other counties, and on past experience in engineering. Since the estimates are for typical profiles, variations from the estimates may be considerable. Following are explanations of the columns in table 5.

Hydrologic soil groups are groups of soils having similar rates of infiltration when wetted, and similar rates of water transmission within the soil. Four such groups are recognized.

Soils in group A have a high infiltration rate, even when thoroughly wetted. They have a high rate of water transmission and low runoff potential. The soils of this group are deep, are well drained or excessively drained, and consist chiefly of sand, gravel, or both.

Soils in group B have a moderate infiltration rate when thoroughly wetted. Their rate of water transmission and their runoff potential are moderate. These soils are moderately deep or deep and moderately well drained or well drained, and they are fine textured to moderately coarse textured.

Soils of group C have a slow infiltration rate when thoroughly wetted. Their rate of water transmission is slow, and their runoff potential is high. These soils have a layer that impedes the downward movement of water, or they are moderately fine or fine textured.

Soils of group D have a slow infiltration rate when thoroughly wetted. Their rate of water transmission is very slow, and runoff potential is very high. In this group are (1) clay soils with high shrink-swell potential; (2) soils with a permanent high water table; (3) soils with a claypan or clay layer at or near the surface; and (4) soils that are shallow over nearly impervious material.

Because their properties are so variable, Breaks-Alluvial land complex (Bk) and Broken alluvial land (Br) were not listed in table 5. Their hydrologic soil group is C.

Permeability relates to movement of water downward through undisturbed soils. The estimates in table 5 are for the soil as it occurs in place and are based on soil structure and porosity. Plowpans, surface crusts, and mechanically created restrictions on permeability are not considered in estimating permeability. Ratings are given for permeability in table 5 only for the least permeable layer.

Available water capacity, in inches per inch of soil depth, is the approximate amount of capillary water in the soil when it is wet to field capacity. When the soil is at the wilting point of common plants, this same amount of water will wet the soil to a depth of 1 inch without deeper percolation.

Reaction is expressed in terms of pH values. A pH of 4.5 to 5.0 indicates very strong acidity, and a pH of 9.1 or higher indicates very strong alkalinity.

Shrink-swell potential refers to the changes in volume of a soil that result from changes in moisture content. Estimates are based on tests for volume change or on observance of other physical properties of the soil. For example, Miller soils have a clay profile and high shrink-swell potential because they are very sticky when wet,

[7] Italic numbers in parentheses refer to Literature Cited, p. 56.

TABLE 5.—*Estimated engineering*

Series name and map symbols [1]	Depth to bedrock	Hydrologic soil group	Depth from surface	Classification: USDA texture
			Inches	
Bonham: BoB, BoC, BoC2	>4	C	0–20	Loam
			20–66	Silty clay loam
Chickasha: CaB, CaC, CaC2	2–4	B	0–10	Loam
			10–42	Sandy clay loam
			42	Sandstone.
Collinsville (Mapped only in complex with Vernon soils.)	1–2	D	0–10	Fine sandy loam
			10	Sandstone.
Crevasse: Cr	>4	A	0–20	Loamy fine sand
			20–54	Fine sand
Dale: Da	>4	C	0–34	Silt loam
			34–55	Very fine sandy loam
Darnell: DsE, DtE3 (For properties of Stephenville soils in these mapping units, refer to the Stephenville series.)	1–2	C	0–4	Fine sandy loam
			4–14	Loamy fine sand
			14–18	Sandstone.
Dougherty: DuD	>4	B	0–26	Loamy fine sand
			26–38	Sandy clay loam
			38–55	Fine sandy loam or loamy fine sand
Eufaula: EdE (For properties of Dougherty soil in this mapping unit, refer to the Dougherty series.)	>4	A	0–50	Fine sand
			50–60	Fine sandy loam
Kirkland: KnA	>4	D	0–10	Silt loam
			10–52	Clay
Konawa: KoB, KoD3	>4	B	0–14	Loamy fine sand
			14–32	Sandy clay loam
			32–60	Sandy loam
Lela: Lc	>4	D	0–55	Clay
Lucien (Mapped only in complex with Vernon.)	1–2	D	0–12	Loam
			12–20	Sandstone.
Mason: Ma	>4	B	0–16	Silt loam
			16–42	Silty clay loam
			42–55	Loam
Miller: Mc	>4	D	0–50	Clay
Noble: NbD	>4	B	0–52	Fine sandy loam
Norge: NoB, NoC, NoC2	>4	C	0–13	Loam
			13–64	Clay loam
Port:				
Pc, Pf	>4	C	0–60	Clay loam
Po	>4	B	0–50	Loam
Pulaski: Ps, Pw	>4	B	0–54	Fine sandy loam
Renfrow:				
ReB, ReC	>4	D	0–9	Silt loam
			9–52	Clay
RfC2	>4	D	0–6	Silty clay loam
			6–52	Clay
Roebuck: Rx	>4	D	0–50	Clay

See footnote at end of table.

properties of soils

Classification—Continued		Percentage passing sieve—			Permeability (of least permeable layer)	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
					Inches per hour	*Inches per inch of soil*	*pH value*	
ML, CL	A-4	100	100	55-85	0. 05-0. 20	0. 14	6. 1-7. 3	Low.
ML-CL	A-6, A-7	100	100	85-95		. 17	6. 1-8. 4	Moderate.
SM, ML	A-4	100	100	40-60		. 14	6. 1-7. 3	Low.
SC, CL	A-6	100	100	40-60	0. 8-2. 5	. 14	5. 6-7. 3	Low.
SM, ML	A-2, A-4	100	100	30-60	2. 5-5. 0	. 14	5. 6-7. 3	Low.
SM	A-2	100	100	15-35		. 07	7. 4-8. 4	Low.
SM-SP	A-3	100	100	5-10	5. 0-10. 0	. 05	7. 4-8. 4	Low.
ML	A-4	100	100	75-95	0. 2-0. 8	. 14	6. 1-7. 3	Low.
ML	A-4	100	100	60-80		. 14	6. 1-8. 4	Low.
SM, ML	A-2, A-4	100	100	30-60		. 14	5. 6-6. 5	Low.
SM	A-2	100	100	15-35	2. 5-5. 0	. 07	5. 6-6. 5	Low.
SM	A-2	100	100	15-35		. 07	5. 6-7. 3	Low.
SC, CL	A-4	100	100	40-60	0. 8-2. 5	. 14	5. 1-6. 5	Low.
SM	A-2, A-4	100	100	15-40		. 12	5. 1-6. 5	Low.
SP-SM	A-3	100	100	5-10	5. 0-10. 0	. 05	5. 6-6. 5	Low.
SM, ML	A-2, A-4	100	100	25-55		. 14	5. 1-6. 5	Low.
ML	A-4	100	100	75-95		. 14	6. 1-7. 3	Low.
CL, CH	A-7	100	100	90-98	<0. 05	. 17	6. 6-8. 4	High.
SM	A-2	100	100	15-35		. 07	5. 6-6. 5	Low.
SC, CL	A-4	100	100	40-60	0. 8-2. 5	. 14	5. 1-6. 5	Low.
SM	A-2, A-4	100	100	15-40		. 12	5. 1-6. 5	Low.
CH, MH	A-7	100	100	90-98	<0. 05	. 17	6. 6-8. 4	High.
ML, CL	A-4	100	100	55-85	0. 8-2. 5	. 14	6. 1-7. 3	Low.
ML	A-4	100	100	75-95		. 14	5. 6-6. 5	Low.
ML-CL	A-6	100	100	85-95	0. 2-0. 8	. 17	6. 1-7. 3	Moderate.
ML, CL	A-4	100	100	60-90		. 14	6. 1-7. 3	Low.
CH, MH	A-7	100	100	90-98	<0. 05	. 17	7. 4-8. 4	High.
SM, ML	A-2, A-4	100	100	30-60	2. 5-5. 0	. 14	5. 6-6. 5	Low.
ML, CL	A-4	100	100	55-85		. 14	6. 1-7. 3	Low.
CL, ML-CL	A-6, A-7	100	100	75-95	0. 2-0. 8	. 17	6. 1-8. 4	Moderate.
CL, ML-CL	A-6, A-7	100	100	75-95	0. 2-0. 8	. 17	6. 1-8. 4	Moderate.
ML, CL	A-4	100	100	55-85	0. 2-0. 8	. 14	6. 1-8. 4	Low.
SM, ML	A-4	100	100	40-60	2. 5-5. 0	. 14	6. 1-7. 3	Low.
ML	A-4	100	100	75-95		. 14	6. 1-7. 3	Low.
CL, CH	A-7	100	100	90-98	<0. 05	. 17	6. 6-8. 4	High.
ML-CL	A-4, A-6	100	100	85-95		. 17	6. 1-7. 3	Moderate.
CL, CH	A-7	100	100	90-98	<0. 05	. 17	6. 6-8. 4	High.
MH, CH	A-7	100	100	90-100	<0. 05	. 17	7. 4-8. 4	High.

TABLE 5.—*Estimated engineering*

Series name and map symbols [1]	Depth to bedrock	Hydrologic soil group	Depth from surface	Classification: USDA texture
			Inches	
Stephenville: StB, StC, StC2	2–4	B	0–14	Fine sandy loam
			14–31	Sandy clay loam
			31–40	Sandstone.
Teller: TeB, TeC, TeC2	>4	B	0–18	Loam
			18–48	Clay loam
			48–56	Loam
Vanoss: VaA, VaB, VaB2	>4	B	0–16	Loam
			16–52	Silty clay loam
Vernon: VcC, VeF, VIE	>4	D	0–5	Clay loam
(For properties of Collinsville soil in mapping unit VeF and Lucien soil in mapping unit VIE, refer to the Collinsville and Lucien series, respectively.)			5–14	Clay
			14–18	Clay beds
Yahola:				
Yc	>4	B	0–10	Clay loam
			10–32	Fine sandy loam
			32–52	Loamy fine sand
Yf	>4	B	0–52	Fine sandy loam
Zaneis: ZaC, ZaC2	2–6	C	0–9	Loam
			9–44	Clay loam
			44–56	Sandy shale.

[1] Because they vary, properties were not estimated for Chickasha and Bonham soils, severely eroded (CbC3); Renfrow-Vernon complex, severely eroded (RvC3); Breaks-Alluvial land complex (Bk); Broken alluvial land (Br); and Wet alluvial land (We).

TABLE 6.—*Engineering*

Soil series and map symbol	Suitability as a source of [1]— Topsoil	Select material	Subgrade	Soil features affecting— Highway location
Bonham: BoB, BoC, BoC2.	Good	Fair: Suitable material to a depth of 1 foot, clayey substratum.	Fair: Moderate shrink-swell potential; unstable material below a depth of 1 foot.	Unstable below a depth of 1 foot.
Breaks-Alluvial land complex: Bk.	Poor: Limited quantity of variable material.	Poor: Limited quantity of variable material.	Poor: Limited quantity of material.	Steep slopes and narrow valleys; requires cuts and fills.
Broken alluvial land: Br.	Poor: Limited quantity of material, much of which is in stream channels.	Fair: Limited quantity of generally good material inaccessible.	Poor: Limited quantity of material.	Frequent flooding; stream channels and adjacent areas.
Chickasha: CaB, CaC, CaC2.	Good	Good: Sandstone at a depth of 3½ feet.	Good: Sandstone at a depth of 3½ feet.	Features favorable
Chickasha and Bonham: CbC3.	Poor: Severely gullied; variable material.	Fair: Severely gullied; variable material.	Fair to good: Variable material.	Variable material; slow percolation rate.

See footnote at end of table.

properties of soils—Continued

Classification—Continued		Percentage passing sieve—			Permeability (of least permeable layer)	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
					Inches per hour	*Inches per inch of soil*	*pH value*	
SM, ML	A–2, A–4	100	100	30–60	--------------	. 14	5. 6–6. 5	Low.
SC, CL	A–4	100	100	40–60	0. 8–2. 5	. 14	5. 6–6. 5	Low.
SC, CL	A–4, A–6	100	100	45–70	0. 8–2. 5	. 14	6. 1–7. 3	Low.
CL	A–6	100	100	60–80	--------------	. 17	6. 1–7. 3	Moderate.
SM, ML	A–4	100	100	45–70	--------------	. 14	6. 1–7. 3	Low.
ML, CL	A–4	100	100	55–85	--------------	. 14	6. 1–7. 3	Low.
ML–CL	A–6	100	100	85–95	0. 8–2. 5	. 17	6. 1–7. 3	Moderate.
CL, ML–CL	A–6, A–7	100	100	75–95	--------------	. 17	7. 4–8. 4	Moderate.
CL, CH	A–7	100	100	90–98	--------------	. 17	7. 4–8. 4	High.
CH	A–7	100	100	90–98	<0. 05	. 17	7. 4–8. 4	High.
ML, CL	A–6, A–7	100	100	75–95	0. 8–2. 5	. 17	7. 4–8. 4	Moderate.
SM, ML	A–2, A–4	100	100	30–60	--------------	. 14	7. 4–8. 4	Low.
SM-----	A–2	100	100	15–35	--------------	. 07	7. 4–8. 4	Low.
SM, ML	A–2, A–4	100	100	30–60	2. 5–5. 0	. 14	7. 4–8. 4	Low.
ML, CL	A–4	100	100	55–85	--------------	. 14	6. 1–7. 3	Low.
CL, ML–CL	A–6	100	100	68–90	0. 2–0. 8	. 17	6. 1–7. 3	Moderate.

interpretations of soils

Soil features affecting—Continued				Limitations for septic tank filter field
Farm ponds		Terraces and diversions	Waterways	
Reservoir area	Embankment			
Features favorable-------	Features favorable-------	Features favorable-----	Features favorable-------	Severe: Slow permeability.
Features favorable-------	Features favorable-------	Steep slopes and narrow valleys.	Steep slopes and narrow valleys.	Severe: Steep slopes and narrow valleys; variable material.
Frequent flooding; sediment.	Mainly in stream channels and adjacent areas.	Mainly in stream channels and adjacent areas.	Mainly in stream channels and adjacent areas.	Severe: Flooding; in stream channels and adjacent areas.
Features favorable-------	Features favorable-------	Features favorable-----	Features favorable-------	Severe: Sandstone at a depth of 3½ feet.
Features generally favorable; source of large amounts of sediment.	Features favorable-------	Severely eroded soils; numerous gullies.	Severely eroded soils; low fertility.	Severe: Variable material; slow permeability in some areas.

TABLE 6.—*Engineering*

Soil series and map symbol	Suitability as a source of [1]—			Soil features affecting—
	Topsoil	Select material	Subgrade	Highway location
Crevasse: Cr	Poor: Easily eroded	Good	Good if slopes are stabilized.	Subject to flooding
Dale: Da	Good to a depth of 3 feet if mixed; surface layer is easily eroded but highly productive.	Fair: Elastic, silty material.	Poor: Unstable when wet.	Features favorable
Darnell-Stephenville: DsE	Poor: Limited quantity of easily eroded material in most places.	Good to fair: Good material over sandstone at depth of 1 to 3 feet.	Fair to poor: Limited quantity of material over sandstone.	Sandstone at depth of 3 feet or less; some outcrops; slopes up to 12 percent.
DtE3	Poor: Limited material of poor quality.	Fair to poor: Material is suitable but generally is too shallow over sandstone.	Poor: Limited quantity of material over sandstone.	Sandstone is at a depth of 1 to 3 feet; crops out in some places; slopes as much as 12 percent.
Dougherty: DuD	Poor: Large quantities of material of poor quality; easily eroded.	Good: Large quantities of good material.	Good if slopes are stabilized.	Cuts easily eroded; other features favorable.
Eufaula-Dougherty: EdE.	Poor: Easily eroded	Good	Good if slopes are stabilized.	Cuts easily eroded; other features favorable.
Kirkland: KnA	Fair to a depth of 1 foot and poor below; underlain by dense clay.	Poor: Limited quantity of elastic, silty material underlain by clay.	Very poor: Clay that has high shrink-swell potential below a depth of 1 foot.	High shrink-swell potential.
Konawa: KoB, KoD3	Poor: Easily eroded	Good	Good if slopes are stabilized.	Cuts erode easily; other features favorable.
Lela: Lc	Poor: Fine-textured, clayey material.	Poor: Clayey material	Very poor: High shrink-swell potential; clayey material.	High shrink-swell potential; unstable; very slow internal drainage.
Mason: Ma	Fair to good: Upper 1½ feet is fair; total profile is good if material is mixed.	Fair to poor: Elastic, silty material to a depth of 1½ feet; clayey substratum.	Fair to poor: Elastic material; moderate shrink-swell potential below a depth of 1½ feet.	Features favorable
Miller: Mc	Poor: Fine-textured, clayey material.	Poor: Clayey material	Very poor: High shrink-swell potential; clayey material.	Subject to flooding; high shrink-swell potential; somewhat poor drainage.
Noble: NbD	Poor: Easily eroded	Good	Good if slopes are stabilized.	Cuts erode easily
Norge: NoB, NoC, NoC2.	Good	Fair: Suitable material to a depth of 1 foot; clayey substratum.	Fair to poor: Moderate shrink-swell potential; unstable below a depth of 1 foot.	Unstable, clayey subsoil.

interpretations of soils—Continued

Soil features affecting—Continued					Limitations for septic tank filter field
Farm ponds		Terraces and diversions	Waterways		
Reservoir area	Embankment				
Very high rate of potential seepage; nearly level relief.	Very high rate of potential seepage.	Nearly level relief; well drained to excessively drained.	Nearly level relief; droughty; flooding.		Severe: Subject to flooding.
Features generally favorable; nearly level relief.	Nearly level relief	Nearly level relief	Nearly level relief		Slight.
Sandstone at depth of 1 to 3 feet.	Limited quantity of material; high rate of potential seepage.	Mixed shallow and deep soils; slopes up to 12 percent.	Mixed shallow and deep soils; slopes up to 12 percent.		Severe: Sandstone at a depth of 1 to 3 feet.
Sandstone at a depth of 1 to 3 feet.	Limited material; high rate of potential seepage.	Severely eroded soils; shallow over sandstone in many places.	Severely eroded soils; low fertility; shallow over sandstone in many places.		Severe: Sandstone at a depth of 1 to 3 feet in most places.
High rate of seepage potential.	High rate of seepage potential; piping hazard.	Somewhat excessive drainage.	Severe susceptibility to gully erosion; droughty.		Slight: Features favorable.
High rate of potential seepage.	High rate of potential seepage; piping hazard.	Somewhat excessive drainage; slopes of 5 to 12 percent.	Severe susceptibility to gully erosion; droughty.		Slight.
Nearly level relief; other features favorable.	Nearly level relief; high shrink-swell potential.	Severe erodibility	Shallow soils underlain by clay; droughty.		Severe: Very slow permeability.
High rate of potential seepage.	High rate of potential seepage; piping hazard.	Somewhat excessive drainage.	Severe susceptibility to gully erosion; droughty.		Slight.
Nearly level relief; other features favorable.	High fills are unstable	Nearly level relief	Nearly level relief; droughty.		Severe: Very slow permeability; somewhat poor drainage.
Nearly level relief; other features favorable.	Nearly level relief	Nearly level relief	Nearly level relief		Severe: Moderately slow permeability.
Nearly level relief; other features favorable.	High fills are unstable	Nearly level relief	Nearly level relief; droughty.		Severe: Very slow permeability.
High rate of potential seepage.	Easily erodible; high rate of potential seepage.	Features favorable	Features favorable		Slight.
Features favorable	Features favorable	Features favorable	Features favorable		Severe: Moderately slow permeability.

TABLE 6.—*Engineering*

Soil series and map symbol	Suitability as a source of [1]—			Soil features affecting—
	Topsoil	Select material	Subgrade	Highway location
Port:				
Pc	Good: Somewhat clayey; large quantity; highly productive.	Poor: Clayey material	Poor: Moderate shrink-swell potential; unstable.	Unstable subsoil; subject to flooding.
Po	Good	Fair to good: Large quantity of material but may be too clayey.	Good	Subject to flooding
Pf	Poor: Poor drainage; subject to ponding.	Poor: Inaccessible; poor drainage; clayey.	Poor: Poor drainage; unstable material.	Poor drainage; seasonal flooding.
Pulaski:				
Ps	Poor: Easily eroded	Good	Good	Subject to flooding and deposition of sediment.
Pw	Poor: Easily eroded	Poor: Water table at surface or within 2 feet.	Poor: Water table at surface or within 2 feet.	Water table at surface or within 2 feet; very poor drainage.
Renfrow: ReB, ReC, RfC2.	Poor to fair: Fair to a depth of less than 1 foot and poor below; underlain by clay.	Poor: Too clayey	Very poor: Clayey in most places; high shrink-swell potential.	Very slow internal drainage; unstable subsoil.
Renfrow-Vernon: RvC3	Poor: Low productivity; clayey subsoil.	Poor: Too clayey	Poor: Clayey material; moderate to high shrink-swell potential.	Clayey material in most places; moderate to high shrink-swell potential.
Roebuck: Rx	Poor: Poor drainage; clay.	Poor: Clayey	Very poor: Clay; high shrink-swell potential; poor drainage.	Subject to flooding; unstable clay.
Stephenville: StB, StC, StC2.	Poor: Easily eroded	Good: Good material to a depth of 2½ feet.	Good: Suitable material underlain by sandstone at a depth of 2 to 4 feet.	Features favorable; rock at a depth of 2 to 4 feet.
Teller: TeB, TeC, TeC2	Good	Good	Good	Features favorable
Vanoss: VaA, VaB, VaB2.	Good	Fair: Suitable to a depth of 1 foot; clayey substratum.	Good if all material in profile is mixed.	Features favorable
Vernon: VcC	Poor: Generally too clayey.	Poor: Too clayey	Poor: Unstable clay underlain by clay beds.	Unstable soils
Vernon-Collinsville: VeF.	Poor: Variable; generally shallow, steep soil.	Poor: Limited quantity of mixed material; steep.	Poor: Generally shallow, steep soils underlain by shale, rock, or clay beds.	Breaks and steep slopes; rock outcrops.
Vernon-Lucien: VlE	Poor: Limited quantity of suitable material; shallow over sandstone or clay beds.	Poor: Limited quantity of suitable material; too clayey in some areas.	Poor: Limited quantity of suitable material; over sandstone or clay beds.	Some areas have sandstone at a depth of less than 2 feet.

interpretations of soils—Continued

Soil features affecting—Continued					Limitations for septic tank filter field
Farm ponds		Terraces and diversions	Waterways		
Reservoir area	Embankment				
Nearly level relief; other features favorable.	Features favorable	Nearly level relief	Nearly level relief		Severe: Subject to flooding.
Nearly level relief; other features favorable.	Features favorable	Nearly level relief	Nearly level relief		Severe: Subject to flooding.
Nearly level relief; subject to ponding.	Poor drainage; other features favorable.	Nearly level relief; subject to ponding.	Nearly level relief; subject to ponding.		Severe: Poor drainage; subject to flooding.
Subject to deposition of sediment; high rate of potential seepage.	High rate of potential seepage; hazard of piping.	Nearly level flood plain.	Nearly level flood plain		Severe: Subject to flooding.
Water table at surface or within 2 feet; subject to deposition of sediment.	High rate of potential seepage; hazard of piping.	Nearly level relief; water table at surface or within 2 feet.	Nearly level relief; water table at surface or within 2 feet.		Severe: Water table at surface or within 2 feet; subject to flooding.
Features favorable	Features favorable	Features favorable	Features favorable		Severe: Very slow permeability.
Source of damaging silt; other features favorable.	Features favorable	Severely eroded soils; numerous gullies.	Severely eroded soils; low fertility, droughty.		Severe: Very slow permeability.
Features favorable	High fills are unstable	Nearly level relief; subject to flooding.	Nearly level relief; subject to flooding.		Severe: Very slow permeability.
Rock at a depth of 2 to 4 feet.	Features favorable	Features favorable	Features favorable		Severe: Rock at a depth of 2 to 4 feet.
Features favorable	Features favorable	Features favorable	Features favorable		Slight.
Features favorable	Features favorable	Features favorable	Features favorable		Slight.
Features favorable	High fills are unstable	Features favorable	Droughty soils		Severe: Very slow permeability.
Steep slopes; shallow over shale, rock, or clay beds.	Steep slopes; limited material.	Nonarable soils	Nonarable soils		Severe: Very slow permeability; steep; shallow over shale, rock, or clay beds.
Slopes of 5 to 15 percent	Slopes of 5 to 15 percent; limited quantity of material in some places.	Nonarable soils	Nonarable soils		Severe: Sandstone or clay beds at a depth of less than 2 feet.

TABLE 6.—*Engineering*

Soil series and map symbol	Suitability as a source of [1]—			Soil features affecting—
	Topsoil	Select material	Subgrade	Highway location
Wet alluvial land: We	Poor: Inaccessible; water table at surface or within 4 feet.	Poor: Inaccessible	Poor: Inaccessible; water table at surface or within 4 feet.	Water table at surface or within 4 feet; subject to flooding.
Yahola: Yc, Yf	Poor: Generally sandy; shallow, clayey surface in some areas.	Good	Good: Large quantities of good material that compacts into stable slopes.	Subject to flooding
Zaneis: ZaC, ZaC2	Good	Poor: Limited quantity of suitable material over clayey substratum.	Poor except for material above a depth of 1 foot; clayey material below that has moderate shrink-swell potential.	Features favorable

[1] A rating of good means large quantities of good material.

TABLE 7.—*Engineering*

[Tests performed by the Oklahoma Department of Highways in accordance with

Soil name and location	Parent material	Oklahoma report No.	Depth	Shrinkage		Volume change from field moisture equivalent (FME)
				Limit	Ratio	
			Inches			*Percent*
Chickasha loam: 1,275 feet N. and 50 feet W. of SE. corner, sec. 36, T. 17 N., R. 4 E. (Modal)	Sandstone and shale.	SO-8733	0–10	18	1. 80	19
		SO-8734	15–24	14	1. 88	32
		SO-8735	24–34	16	1. 84	22
Dale silt loam: 400 feet N. and 2,250 feet W. of SE. corner, sec. 30, T. 12 N., R. 2 E. (Modal)	Alluvium.	SO-8726	0–14	21	1. 67	10
		SO-8727	14–40	20	1. 66	8
Pulaski fine sandy loam: 150 feet E. and 150 feet S. of N¼ corner, sec. 29, T. 13 N., R. 2 E. (Modal)	Alluvium.	SO-8728	0–14	17	1. 78	4
		SO-8729	14–50	[3] NP	[3] NP	[3] NP
Roebuck clay: 3,500 feet W. and 100 feet S. of NE. corner, sec. 30, T. 14 N., R. 4 E. (Modal)	Alluvium.	SO-8721	0–10	10	2. 01	86
		SO-8722	10–46	8	2. 10	92
Teller loam: 100 feet N. and 50 feet E. of the SW. corner, sec. 28, T. 12 N., R. 3 E. (Nonmodal)	Alluvium from high terraces.	SO-8723	0–6	15	1. 86	8
		SO-8724	6–16	13	1. 93	32
		SO-8725	36–52	17	1. 79	11
Zaneis loam: 1,000 feet N. and 50 feet E. of SW. corner, sec. 31, T. 17 N., R. 3 E. (Modal)	Sandstone and shale.	SO-8730	0–8	14	1. 57	34
		SO-8731	13–24	16	1. 74	31
		SO-8732	32–40	14	1. 87	20

[1] Mechanical analyses according to the AASHO Designation T 88–57 (*1*). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses data

interpretations of soils—Continued

Soil features affecting—Continued				Limitations for septic tank filter field
Farm ponds		Terraces and diversions	Waterways	
Reservoir area	Embankment			
Water table at surface or within 4 feet.	Mixed sediments	Nonarable marsh land	Nonarable land	Severe: Water table at surface or within 4 feet; subject to flooding.
High rate of potential seepage; subject to flooding.	High rate of potential seepage.	Nearly level relief	Nearly level relief; subject to flooding.	Severe: Subject to flooding.
Features favorable	Features favorable	Features favorable	Features favorable	Moderate: Rock at a depth of 2 to 5 feet.

test data

procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [1]						Liquid limit	Plasticity index	Classification	
Percentage passing sieve—			Percentage smaller than—					AASHO	Unified [2]
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.				
100	99	45	39	20	16	27	6	A-4(2)	SM-SC.
100	99	49	44	34	30	36	15	A-6(5)	SC.
100	98	41	38	31	29	32	12	A-6(2)	SC.
	100	92	69	15	13	29	5	A-4(8)	ML-CL.
	100	87	63	12	11	25	1	A-4(8)	ML.
	100	53	34	13	11	20	2	A-4(4)	ML.
	100	41	23	12	10	[3]NP	[3]NP	A-4(1)	SM.
		100	96	79	63	67	33	A-7-5(20)	MH-CH.
	100	99	96	70	56	60	31	A-7-6(20)	MH-CH.
	100	48	36	20	18	21	4	A-4(3)	SM-SC.
	100	65	55	33	30	34	14	A-6(8)	CL.
	100	48	31	22	20	24	5	A-4(3)	SM-SC.
	100	84	71	20	16	37	8	A-4(8)	ML.
100	99	87	74	35	30	36	13	A-6(9)	ML-CL.
100	98	69	55	30	24	27	9	A-4(7)	CL.

used in this table are not suitable for use in naming textural classes for soil.

[2] The Soil Conservation Service and the Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within 2 points of A-line are to be given a borderline classification. Examples of borderline classifications thus obtained are ML-CL, SM-SC, and MH-CH.

[3] NP=Nonplastic.

and they shrink and crack a great deal when they dry. In contrast, the profile of Eufaula soils has low shrink-swell potential because those soils are nonplastic.

Engineering interpretations of soils

In table 6 the soils of Lincoln County are rated according to their suitability as a source of topsoil, select material, and road fill. Also pointed out are those features affecting suitability as sites for highways, farm ponds, terraces and diversions, and waterways. Also given in table 6 is a rating of limitations to the use of the soils for septic tank filter fields. The information in table 6 is based on the estimated engineering properties in table 5, the actual test data in table 7, and field experience with the soils.

Topsoil is presumed to be fertile soil, or soil material, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens. The suitability of a soil as a source of topsoil depends largely on texture and depth. Topsoil should be of a texture that can be worked into a good seedbed, yet is clayey enough to resist erosion on strong slopes. The depth of suitable soil material determines whether or not the soil is economical to use as topsoil.

The suitability rating for select material depends mainly on grain size and the content of silt and clay. Soils consisting mainly of sand are good grading material if a binder is added to increase cohesion. Clay soils, in contrast, are poor grading material because they compress under load and rebound when unloaded.

Subgrade can be of almost any kind of a soil material. Sandy clays and sandy clay loams are easy to place and to compact. Clays having high shrink-swell potential, however, require special compaction and close moisture control both during and after construction. Sands compact well but are difficult to confine in a fill. The ratings in table 6 reflect the various limitations and advantages of different kinds of soil material.

Soil features listed in the remaining columns of table 6 were selected on the basis of the estimated classification of the soils and on other important features, such as slope, susceptibility to flooding, and shrink-swell potential. For example, Roebuck clay and Miller clay have high shrink-swell potential and are poorly suited as locations for highways.

Crevasse loamy fine sand has a very high rate of potential seepage and therefore does not provide good reservoir areas for ponds. Yahola soils are frequently flooded and are not good as reservoir areas. Use of soils for embankments of ponds is impaired by stoniness, bedrock near the surface, and rapid permeability of the soil material.

Among the soil features that affect suitability of a soil for constructing terraces and diversions are slope, depth to bedrock, texture, and stability of the soil material. Field terraces are difficult to build on Darnell-Stephenville complex, 3 to 12 percent slopes, severely eroded, because sandstone is near the surface, slopes are too strong, and erosion is a hazard.

Grassed waterways are used on soils to carry off water discharged from terrace outlets, diversion outlets, and other areas. The severely eroded Chickasha and Bonham soils are low in natural fertility; they are not suitable for constructing waterways.

The last column in table 6 rates the limitations of the soils to use for septic tank filter fields. Among these limitations are steep slopes, susceptibility to flooding, bedrock near the surface, and slow or very slow permeability. Kirkland soils are very slowly permeable and their use for septic tank filter fields is severely limited.

Engineering test data

Table 7 contains the test data for samples collected from selected soils and tested by the State Highway Department. The tests were made for the purpose of determining shrinkage, volume change, liquid limit, and plasticity index. A mechanical analysis of each sample was made so that the percentage of the various-sized particles could be determined.

The column headed "Shrinkage" lists values for shrinkage limit and shrinkage ratio. As moisture is removed, the volume of a soil decreases in direct proportion to the loss of moisture until the shrinkage limit is reached. Beyond the shrinkage limit, more moisture may be removed, but the volume of the soil does not change. In general, the lower the number listed in table 7 for the shrinkage limit, the higher the content of clay.

The shrinkage ratio is the volume change, expressed as the percentage of the volume of dry soil material, divided by the loss of moisture caused by drying. This ratio is expressed numerically.

The field moisture equivalent (FME) is the minimum moisture content at which a smooth soil surface will not absorb any more water in 30 seconds when the water is added in individual drops. It is the moisture content required to fill all the pores in sands and to approach saturation in cohesive soil. The volume change from field moisture equivalent is the change in volume, expressed as a percentage of the dry volume, that takes place when the moisture content of the soil is reduced from the field moisture equivalent to the shrinkage limit.

In mechanical analysis, the soil components are sorted by particle size. Sand and other granular material are retained on the No. 200 sieve, but silt and clay materials pass through it. Clay is the fraction that passes the No. 200 sieve and is smaller than 0.002 millimeter in diameter. The material intermediate in size between that held on the No. 200 sieve and that having a diameter of 0.002 millimeter is called silt.

Liquid limit and plastic limit indicate the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material passes from a plastic to a liquid state. The *plastic limit* is the moisture content at which the soil material passes from a semisolid to a plastic state. The *liquid limit* is the moisture content at which the material changes from a plastic to a liquid state. The *plasticity index* is the numerical difference between the liquid limit and plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Formation and Classification of Soils

Discussed in this section are the five major factors of soil formation, some of the common processes that take place in soils of the county, and the classification of the soils by higher categories.

Factors of Soil Formation

Soil is the product of five major factors of soil formation—climate, living organisms (especially vegetation), parent material, relief, and time. If a factor such as climate or vegetation differs in one area from the same factor in another area, but the other four factors are the same, the soil formed in one area differs from that formed in the other area.

Climate

The warm-temperate climate of Lincoln County is characterized by rains of high intensity. Moisture and warm temperatures have been sufficient to promote the formation of distinct horizons in many of the soils. Differences in soils, however, cannot be attributed to climate, because the climate is uniform throughout the county. Heavy rains have caused rapid runoff that has severely eroded many of the soils. This erosion is an indirect effect of climate.

Living organisms

Plants, burrowing animals, insects, and soil microorganisms have a direct influence on the formation of soils. The native grasses and the trees in the county have had different effects on the losses and gains of organic matter and plant nutrients, and on soil structure and porosity. The Bonham, Renfrow, Norge, and Zaneis soils formed on the prairie under native grasses. The fibrous roots of these native grasses promote a good granular structure and add organic matter to the soil. Large amounts of plant nutrients are not lost from soil formed under native grass, because roots take in nutrients from deep in the soil and return a large part of them when the grass dies. Also, soils formed on the prairie under native grass generally are less acid than soils formed under trees. The Darnell and Stephenville soils developed under scrub oaks are lighter colored, more acid, and lower in content of organic matter than soils formed on the prairie under grass.

During the past 60 years man has altered the natural soil-forming processes in much of the county. His clearing and cultivation of the soils have resulted in tremendous loss of soil through sheet and gully erosion. The severely eroded Konawa, Chickasha, and Bonham soils are in areas where much of the surface layer has been removed. Man's activity on the Deep Fork North Canadian River has contributed to large areas of recently silted sediment that have poor surface drainage.

Parent material

Parent material, the unconsolidated material from which soils form, has a direct influence on the physical, chemical, and mineralogical composition of soils. The soils of Lincoln County have developed mainly from parent material of late Pennsylvanian, Early Permian, Quaternary, and Recent ages. Extensive areas of Bonham soils have formed from the older, darker clays and shales of Pennsylvanian age in the eastern part of the county. The redder Permian clays, shales, and sandstone of the Wellington formation and the Admire group are the parent materials of the Kirkland, Renfrow, Vernon, and other soils of the prairie. These soils are residual and have a clayey subsoil that is similar to their parent material, which typically is alkaline or calcareous. The Chickasha and Zaneis are other soils of the prairie formed in residual material weathered from sandstone. These soils have a loamy subsoil. In the formation of the Stephenville and Darnell soils, large areas of acid sandstone have influenced the kind of climax vegetation that grew, and together with this vegetation, have promoted the development of a leached, weathered profile.

The loamy to sandy Quaternary deposits that occur intermittently along the larger streams and rivers are parent materials of the Norge, Vanoss, Teller, Dougherty, Konawa, and Eufaula soils. The Norge, Vanoss, and Teller soils developed in older loamy deposits that contained large amounts of weatherable minerals, but the Konawa, Dougherty, and Eufaula soils developed in more sandy deposits.

Alluvial sediments are extensive along the streams and rivers of the county. The kinds of sediments deposited and the kinds of soils that formed in them largely depend on the source of sediments and the velocity of the floodwaters. Because the Pulaski soils were derived from sediments that washed from the Stephenville and Darnell soils, Pulaski soils have an acid, reddish-brown fine sandy loam profile that is similar to the profile of those soils. The Yahola, Crevasse, and Miller soils are typically calcareous. They formed in nonacid material along rivers that was brought in from areas to the west. Crevasse and Yahola soils formed near the rivers where swiftly moving floodwaters drop the larger sized sand particles, but the Miller soils formed away from the rivers in clay and silt deposited by slowly moving floodwaters. The sandy Crevasse and Yahola soils are excessively drained, but the clayey Miller soils are somewhat poorly drained.

Relief

Relief affects the formation of soils through its influence on drainage, erosion, temperature of the soil, and plant cover. In Lincoln County relief is determined largely by the resistance of underlying formations to weathering and geological erosion. About 17 percent of Lincoln County consists of nearly level soils on bottom lands, and about 83 percent consists of nearly level to strongly sloping soils on uplands.

The general relief of the county is relatively uniform, but geological erosion has dissected broad plains and has cut drainageways in them. Because of this cutting, differences in elevation are distinct. The more sloping, dissected part of the county includes the Cross Timbers area. The highest part is on the prairies in the northern part of Lincoln County.

Relief has had much to do with the development of different profile characteristics in the clayey parent material of the Kirkland, Renfrow, and Vernon soils. Because the dark Kirkland soils are nearly level and less water runs off the surface than from the more sloping

Renfrow and Vernon soils, more water percolates through the profile of the Kirkland soils. This percolation influences the loss, gain, or transfer of soil constituents. Renfrow and Vernon soils occur with the Kirkland but are more reddish. The deep Renfrow soils are very gently sloping, but the shallow Vernon soils are more sloping.

Stephenville and Darnell soils formed from similar sandstone parent material, but their development has been controlled to a large extent by relief. The deep to moderately deep Stephenville soils are less sloping than the shallow Darnell soils. Much of the rainfall runs off the more sloping Darnell soils and does not percolate through the profile. If this water did percolate through the profile, it would promote development of a deeper solum.

The relief of the bottom lands is closely related to soil drainage. The level or slightly depressional Lela and Miller soils are somewhat poorly drained, but the nearly level Port loam, occasionally flooded, is well drained. The changing of grade that takes place in Lincoln County in the lower reaches of the Deep Fork North Canadian River has had a tremendous effect on vast areas of recently deposited sandy to clayey sediments that restrict surface drainage.

Time

Time as a factor in soil formation cannot be measured strictly in years. The length of time needed for the development of genetic horizons depends on the intensity and the interactions of the soil-forming factors in promoting the losses, gains, transfers, or transformations of soil constituents that are necessary for forming soil horizons. Soils with no definite genetic horizons are young or immature. Mature or older soils have approached equilibrium with their environment and tend to have well-defined horizons.

The soils of Lincoln County range from young to old. Some of the old, mature soils are the Kirkland, Renfrow, and Bonham on the uplands. The Vanoss, Norge, and Teller soils are younger, but they have well-expressed soil horizons. The Vernon, Lucien, and Collinsville soils are considered young soils. They have had sufficient time to develop well-expressed horizons, but because they are sloping, geological erosion has taken away soil material as fast, or almost as fast, as it has formed. The Yahola, Port, Pulaski, and Miller soils are on bottom lands and have been developing for such a short time that they show little horizon development. Mason soils have formed in loamy alluvial parent material similar to that of the Port soils, but this material has been in place long enough for the development of a distinct subsoil and a dark-colored surface layer.

Processes of Horizon Differentiation

Processes that have influenced the formation of horizons in the soils of Lincoln County are (1) accumulation of organic matter, (2) leaching of calcium carbonates and bases, and (3) translocation of silicate clay minerals. In most soils, more than one of these processes have been active in the development of horizons. Some processes have retarded horizon differentiation.

By adding organic matter to the surface layer, native grasses have contributed to the granular structure of that layer in soils on the prairie. The Vanoss soils have a dark, granular surface layer that is high in content of organic matter. The light-colored Stephenville soils formed from sandstone under native trees and contain less organic matter than the Vanoss soils.

Leaching of calcium carbonates and bases has occurred in almost all of the soils in the county. In the Kirkland, Renfrow, and Bonham soils, the accumulation of calcium carbonate and bases in the lower part of the B horizon indicates the depth to which water has percolated. The Vanoss, Teller, Norge, Zaneis, and Chickasha soils have been leached to the extent that they have no accumulations of calcium carbonate. Konawa, Dougherty, and Eufaula soils have a distinct A2 horizon that has been leached of bases. The B horizon of these soils has had much leaching of bases that is reflected by moderately low base saturation.

Young alluvial soils, such as the Crevasse and Yahola, are recharged with bases during each flood. The acid Pulaski soils have not been leached, but their sediments come from the leached, acid Stephenville and Darnell soils. The shallow Vernon soils formed in Permian red beds and are high in calcium carbonate. Accumulations of calcium carbonate in Vernon soils are related to the nature of the parent material rather than to leaching.

The translocation of silicate clay minerals has contributed to horizon development in some of the soils in Lincoln County. Illuviation of clay is significant in the formation of clayey horizons. These horizons can be identified by their clay films along vertical and horizonal surfaces of peds and by the increase in total clay. A horizon containing much translocated clay occurs in the Vanoss, Kirkland, Renfrow, Zaneis, and other soils in the county. The texture and structure of the clayey horizons in the soils of Lincoln County vary considerably because of the variation in the degree of translocation of silicate clay minerals and in variation in the kind of parent material. The Stephenville, Konawa, Dougherty, and Eufaula soils have a surface layer that is more intensely leached of silicate clay minerals than the surface layer of other soils in the county.

The grasses on the soils of the prairie bring bases to the surface and thus retard complete leaching and the formation of A2 horizons. Geological erosion on sloping, shallow Vernon, Collinsville, and Lucien soils deters horizonation through soil losses. The sediments of the Crevasse, Yahola, Pulaski, and other soils on bottom land were deposited so recently that there has not been enough time for the formation of horizons.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationships to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First, through classification and then through the use of soil maps, we can apply our knowledge of soils to specific fields or other tracts of land.

Thus, in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and applied in managing farms, fields, and woodlands, in developing rural areas; in engineering work; and in many other ways. They are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and later revised (*5*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study. Therefore, readers interested in development of this system should search the latest literature available (*4*, *7*). In table 8, the soil series represented in Lincoln County are placed in higher categories of the current system. The classes of the current system are briefly defined in the following paragraphs:

ORDER: Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groups. The two exceptions, Entisols and Histosols, occur in many different climates.

Table 8 lists the four soil orders represented in Lincoln County—Entisols, Inceptisols, Mollisols, and Alfisols.

Entisols are recently formed soils that do not have genetic horizons or have only the beginning of such horizons. The Entisols in Lincoln County were formerly called Alluvial soils.

Inceptisols generally occur on young but not recent land surfaces, and their name is derived from the Latin *inceptum* meaning beginning. Inceptisols have weakly expressed horizons. The Inceptisols in Lincoln County were formerly called Lithosols or Alluvial soils.

Mollisols developed mainly under grass and have well-formed genetic horizons. They have a dark surface layer that is high in content of organic matter. The Mollisols in this county were formerly called Reddish Prairie soils, Lithosols, Alluvial soils, or Brunizems.

Alfisols have a clay-enriched B horizon that is high in base saturation. They lack the dark surface layer of Mollisols and the high content of organic matter. The Alfisols in Lincoln County were formerly called Red-Yellow Podzolic soils.

SUBORDER: Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborder narrows the broad climatic range

TABLE 8.—*Soil series classified according to current and old systems of classification*

Series	Current classification [1]			1938 classification (with later revisions)
	Family	Subgroup	Order	Great soil group
Bonham [2]	Fine, mixed, thermic	Aquic Argiudolls	Mollisols	Reddish Prairie soils.
Chickasha	Fine-loamy, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Collinsville	Loamy, mixed, thermic	Lithic Hapludolls	Mollisols	Lithosols.
Crevasse	Mixed, thermic	Typic Udipsamments	Entisols	Alluvial soils.
Dale	Fine-silty, mixed, thermic	Pachic Haplustolls	Mollisols	Alluvial soils.
Darnell	Loamy, siliceous, thermic, shallow	Udic Ustochrepts	Inceptisols	Lithosols.
Dougherty	Loamy, mixed, thermic	Arenic Haplustalfs	Alfisols	Red-Yellow Podzolic soils.
Eufaula [2]	Sandy, siliceous, thermic	Psammentic Paleustalfs	Alfisols	Red-Yellow Podzolic soils.
Kirkland	Fine, mixed, thermic	Abruptic Paleustolls	Mollisols	Reddish Prairie soils.
Konawa	Fine-loamy, mixed, thermic	Ultic Haplustalfs	Alfisols	Red-Yellow Podzolic soils.
Lela	Fine, mixed, thermic	Typic Chromoderts	Vertisols	Alluvial soils.
Lucien	Loamy, mixed, thermic, shallow	Typic Haplustolls	Mollisols	Lithosols.
Mason	Fine-silty, mixed, thermic	Typic Argiudolls	Mollisols	Brunizems.
Miller	Fine, mixed, thermic	Vertic Haplustolls	Mollisols	Alluvial soils.
Noble	Coarse-loamy, siliceous, thermic	Udic Ustochrepts	Inceptisols	Alluvial soils.
Norge	Fine-silty, mixed, thermic	Udic Paleustolls	Mollisols	Reddish Prairie soils.
Port [2]	Fine-silty, mixed, thermic	Cumulic Haplustolls	Mollisols	Alluvial soils.
Pulaski	Coarse-loamy, mixed, nonacid, thermic	Typic Ustifluvents	Entisols	Alluvial soils.
Renfrow	Fine, mixed, thermic	Udertic Paleustolls	Mollisols	Reddish Prairie soils.
Roebuck	Fine, montmorillonitic, thermic	Vertic Hapludolls	Mollisols	Alluvial soils.
Stephenville	Fine-loamy, siliceous, thermic	Ultic Haplustalfs	Alfisols	Red-Yellow Podzolic soils.
Teller	Fine-loamy, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Vanoss	Fine-silty, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Vernon [2]	Fine, mixed, thermic	Typic Ustochrepts	Inceptisols	Lithosols.
Yahola	Coarse-loamy, mixed, calcareous, thermic.	Typic Ustifluvents	Entisols	Alluvial soils.
Zaneis	Fine-loamy, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.

[1] Placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

[2] Classification of these series was changed shortly before the survey was sent to the printer. These soils are now outside the named series, and new series have not been proposed.

permitted in the orders. The soil properties used to separate suborders mainly reflect either the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation.

Great Group: Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that have pans interfering with growth of roots or movement of water. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown in table 8, because it is the last word in the name of the subgroup.

Subgroup: Great groups are subdivided into subgroups, one that represents the central (typic) segment of the group and others, called intergrades, that have properties of one group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Hapludolls (typical Hapludolls).

Family: Families are separated within the subgroup primarily on the basis of properties important to growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

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Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: Clay coat, clay skin.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Hard grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds that cement the soil grains together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent; will not hold together in a mass.

Friable.—When moist, crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a wire when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material; tends to stretch somewhat and pull apart, rather than pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grades.

Cover crop. A close-growing crop grown primarily to improve and to protect the soil between periods of regular crop production; or a crop grown between trees and vines in orchards and vineyards.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residue.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, or sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has (1) distinctive characteristics caused by accumulation of clay, sesquioxides, humus, or some combination of these; (2) prismatic or blocky structure; (3) redder or stronger colors than the A horizon; or (4) some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be beneath an A or B horizon:

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the solum and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, value of 6, and a chroma of 4.

Parent material (soil). The horizons of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *Very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Plowpan. A compacted layer formed in the soil immediately below the plow layer.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. See Horizon, soil.

Reaction, soil. The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction, because it is neither acid nor alkaline. In words the degrees of acidity of alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Savannah. Dry grassland that contains isolated or scattered trees or shrubs.

Silt. Individual mineral particles in a soil that range in diamete from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slope. Any land surface marked by an ascent or descent, as a hillside or terrace escarpment. The slope of a soil in percent is the vertical rise in feet for every 100 feet of horizontal distance. In this soil survey the percentages of ranges in slope and their corresponding verbal designations are: 0 to 1 percent, nearly level; 1 to 3 percent, very gently sloping; 3 to 5 percent, gently sloping; 5 to 8 percent, sloping; 8 to 12 percent, strongly sloping; 12 to 30 percent, moderately steep.

Structure, soil. The arrangement of primary soil particles int compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer lying beneath the solum, or true soil.

Surface layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called *second bottoms,* as contrasted to *flood plains,* and are seldom subject to overflow. Marine terraces formed from material deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. (See also clay, sand, and silt.) The basic, textural classes, in order of increasing proportions of fine particles are as follows: *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The *sands, loamy sand,* and *sandy loam* classes may be further divided by specifying "coarse," "fine," and "very fine."

Tilth, soil. The condition of the soil, especially of soil structure, in relation to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

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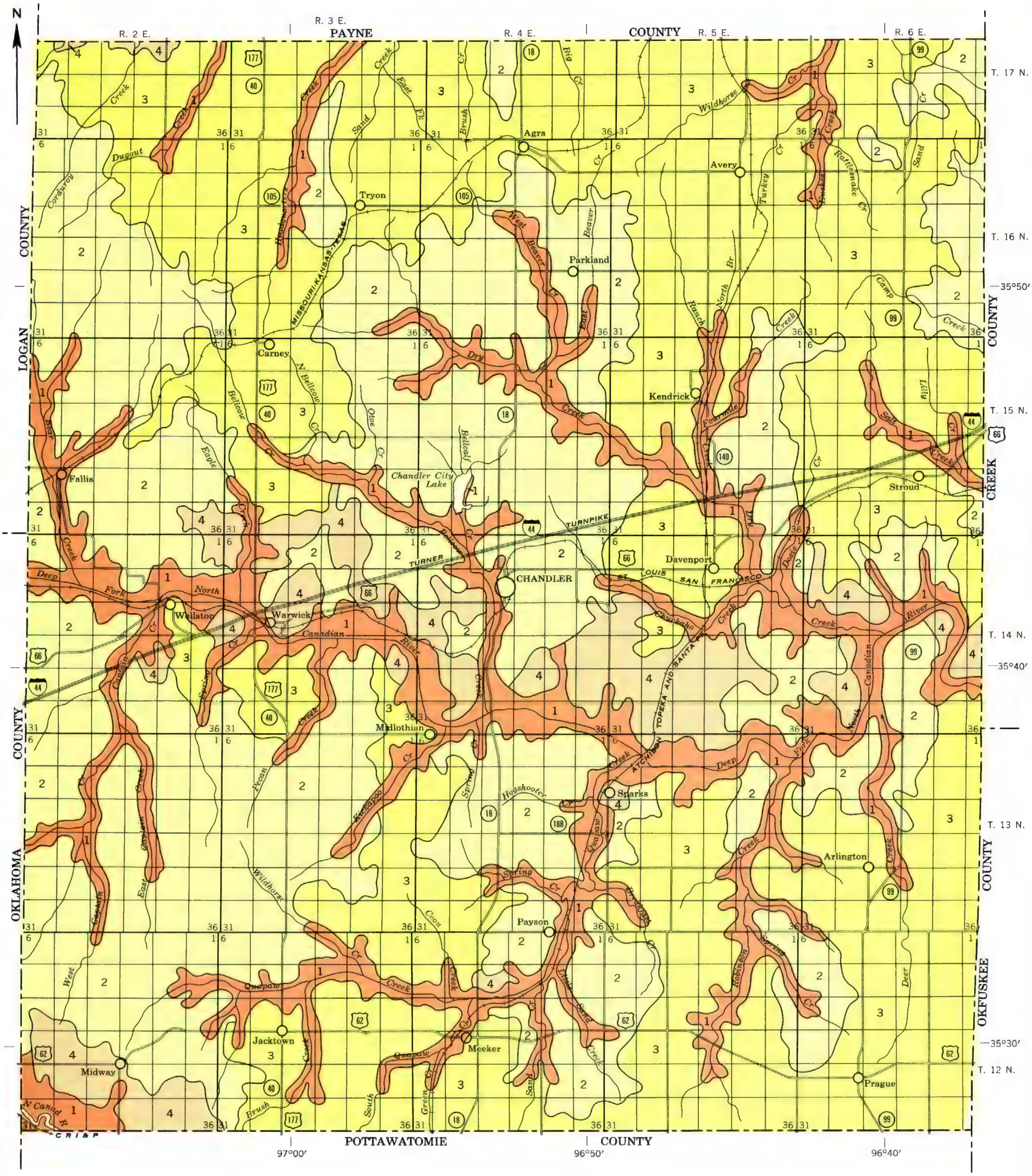


SOIL ASSOCIATIONS

1	Port–Pulaski association: Deep, level and nearly level, loamy soils on flood plains
2	Darnell–Stephenville association: Very gently sloping to strongly sloping, loamy soils, very shallow to deep over sandstone, on forested uplands
3	Renfrow–Vernon–Bonham association: Very gently sloping to moderately steep, loamy soils, deep to shallow over clay or shale, on prairie uplands
4	Konawa–Dougherty–Teller association: Deep, nearly level to strongly sloping, sandy to loamy soils on uplands

October 1968

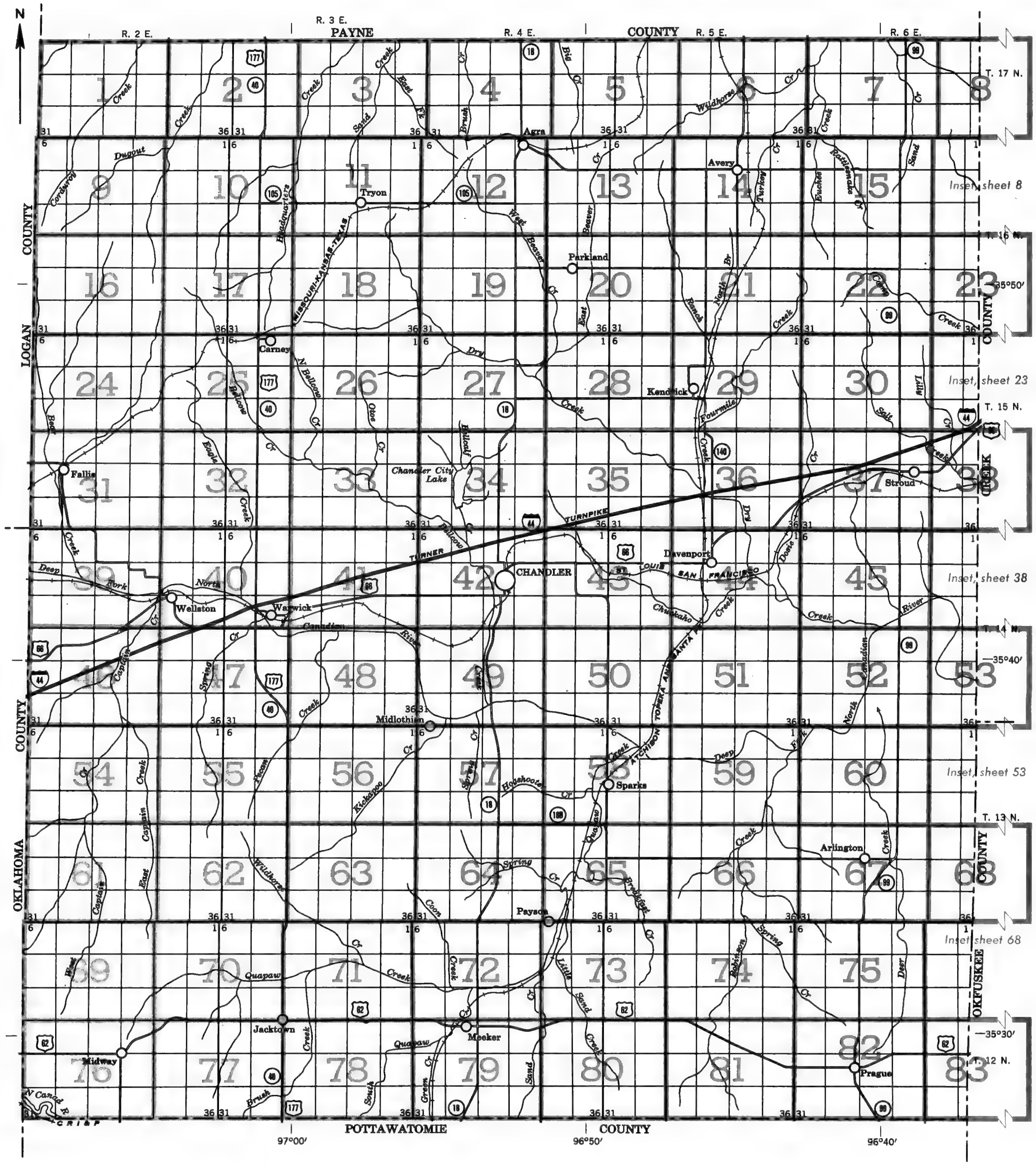
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
OKLAHOMA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

LINCOLN COUNTY, OKLAHOMA

SCALE IN MILES

1 0 1 2 3 4



Original text from each map sheet:
"This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station."

"Land division corners are approximately positioned on this map."

INDEX TO MAP SHEETS
LINCOLN COUNTY, OKLAHOMA

SCALE IN MILES
1 0 1 2 3 4

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F, shows the slope. Most symbols without a slope letter are those of nearly level soils or land types, but some are for soils or land types that have a considerable range in slope. A final number, 2 or 3, in the symbol shows that the soil is eroded or severely eroded.

SYMBOL	NAME
BoB	Bonham loam, 1 to 3 percent slopes
BoC	Bonham loam, 3 to 5 percent slopes
BoC2	Bonham loam, 2 to 5 percent slopes, eroded
Bk	Breaks–Alluvial land complex
Br	Broken alluvial land
CaB	Chickasha loam, 1 to 3 percent slopes
CaC	Chickasha loam, 3 to 5 percent slopes
CaC2	Chickasha loam, 2 to 5 percent slopes, eroded
CbC3	Chickasha and Bonham soils, 2 to 6 percent slopes, severely eroded
Cr	Crevasse loamy fine sand
Da	Dale silt loam
DsE	Darnell–Stephenville fine sandy loams, 3 to 12 percent slopes
DtE3	Darnell–Stephenville complex, 3 to 12 percent slopes, severely eroded
DuD	Dougherty loamy fine sand, 3 to 8 percent slopes
EdE	Eufaula–Dougherty complex, 5 to 12 percent slopes
KnA	Kirkland silt loam, 0 to 1 percent slopes
KoB	Konawa loamy fine sand, 0 to 3 percent slopes
KoD3	Konawa loamy fine sand, 3 to 8 percent slopes, severely eroded
Lc	Lela clay
Ma	Mason silt loam
Mc	Miller clay
NbD	Noble fine sandy loam, 3 to 8 percent slopes
NoB	Norge loam, 1 to 3 percent slopes
NoC	Norge loam, 3 to 5 percent slopes
NoC2	Norge loam, 2 to 5 percent slopes, eroded
Pc	Port clay loam, occasionally flooded
Pf	Port clay loam, frequently flooded
Po	Port loam, occasionally flooded
Ps	Pulaski fine sandy loam
Pw	Pulaski soils, wet
ReB	Renfrow silt loam, 1 to 3 percent slopes
ReC	Renfrow silt loam, 3 to 5 percent slopes
RfC2	Renfrow silty clay loam, 2 to 5 percent slopes, eroded
RvC3	Renfrow–Vernon complex, 2 to 5 percent slopes, severely eroded
Rx	Roebuck clay
StB	Stephenville fine sandy loam, 1 to 3 percent slopes
StC	Stephenville fine sandy loam, 3 to 5 percent slopes
StC2	Stephenville fine sandy loam, 2 to 5 percent slopes, eroded
TeB	Teller loam, 1 to 3 percent slopes
TeC	Teller loam, 3 to 5 percent slopes
TeC2	Teller loam, 2 to 5 percent slopes, eroded
VaA	Vanoss loam, 0 to 1 percent slopes
VaB	Vanoss loam, 1 to 3 percent slopes
VaB2	Vanoss loam, 1 to 3 percent slopes, eroded
VcC	Vernon clay loam, 3 to 5 percent slopes
VeF	Vernon–Collinsville complex, 5 to 20 percent slopes
VlE	Vernon–Lucien complex, 5 to 15 percent slopes
We	Wet alluvial land
Yc	Yahola clay loam
Yf	Yahola fine sandy loam
ZaC	Zaneis loam, 3 to 5 percent slopes
ZaC2	Zaneis loam, 3 to 5 percent slopes, eroded

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries

Mine dump

Pits, gravel or other

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

BOUNDARIES

- National or state
- County
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches (CANAL)

Lakes and ponds
- Perennial (water, w)
- Intermittent

Wells, water (flowing)

Spring

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

RELIEF

Escarpments
- Bedrock
- Other

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stony, very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully

Soil map constructed 1967 by Cartographic Division, Soil Conservation Service, USDA, from 1961 aerial photographs. Controlled mosaic based on Oklahoma plane coordinate system, north zone, Lambert conformal conic projection, 1927 North American datum.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the soil series to which it belongs. For information about the use of soils for woodland, see the section beginning on p. 38, and for information about the use of soils for wildlife, see the section beginning on p. 39. Other information is given in tables as follows:

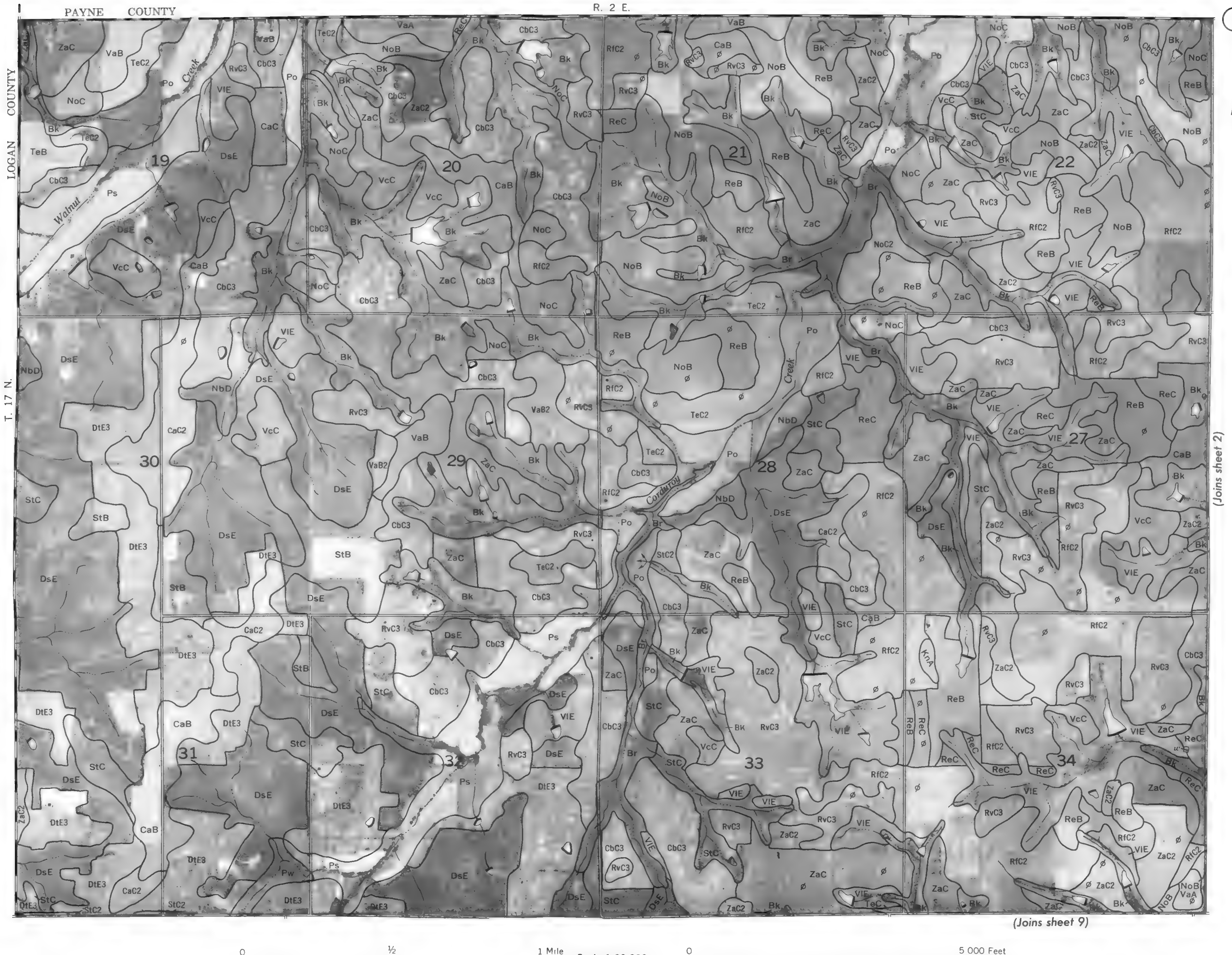
Acreage and extent, table 3, p. 7.
Predicted yields, table 4, p. 30.

Engineering uses of the soils, tables 5, 6, and 7, pp. 42 through 51.

Map symbol	Mapping unit	Page	Capability unit	Range site		Woodland suitability group
			Symbol	Name	Page	Number
BoB	Bonham loam, 1 to 3 percent slopes	8	IIe-1	Loamy Prairie	33	2
BoC	Bonham loam, 3 to 5 percent slopes	8	IIIe-2	Loamy Prairie	33	2
BoC2	Bonham loam, 2 to 5 percent slopes, eroded	8	IIIe-5	Loamy Prairie	33	3
Bk	Breaks-Alluvial land complex	8				
	Breaks	--	VIe-7	Loamy Prairie	33	4
	Alluvial land	--	VIe-7	Loamy Bottomland	38	4
Br	Broken alluvial land	9	Vw-2	Loamy Bottomland	38	2
CaB	Chickasha loam, 1 to 3 percent slopes	9	IIe-1	Loamy Prairie	33	2
CaC	Chickasha loam, 3 to 5 percent slopes	10	IIIe-2	Loamy Prairie	33	2
CaC2	Chickasha loam, 2 to 5 percent slopes, eroded	10	IIIe-5	Loamy Prairie	33	3
CbC3	Chickasha and Bonham soils, 2 to 6 percent slopes, severely eroded	10	VIe-6	Eroded Prairie	33	3
Cr	Crevasse loamy fine sand	11	IIIe-7	Sandy Bottomland	38	1
Da	Dale silt loam	11	I-1	Loamy Bottomland	38	1
DsE	Darnell-Stephenville fine sandy loams, 3 to 12 percent slopes	12				
	Darnell soil	--	VIe-5	Shallow Savannah	37	3
	Stephenville soil	--	VIe-5	Sandy Savannah	36	3
DtE3	Darnell-Stephenville complex, 3 to 12 percent slopes, severely eroded	12				
	Darnell soil	--	VIe-3	Eroded Shallow Savannah	36	4
	Stephenville soil	--	VIe-3	Eroded Sandy Savannah	35	4
DuD	Dougherty loamy fine sand, 3 to 8 percent slopes	13	IVe-4	Deep Sand Savannah	35	2
EdE	Eufaula-Dougherty complex, 5 to 12 percent slopes	14	VIs-1	Deep Sand Savannah	35	2
KnA	Kirkland silt loam, 0 to 1 percent slopes	14	IIs-1	Claypan Prairie	33	3
KoB	Konawa loamy fine sand, 0 to 3 percent slopes	15	IIIe-4	Deep Sand Savannah	35	2
KoD3	Konawa loamy fine sand, 3 to 8 percent slopes, severely eroded	15	VIe-2	Deep Sand Savannah	35	3
Lc	Lela clay	16	IIIw-1	Heavy Bottomland	37	3
Ma	Mason silt loam	17	I-1	Loamy Bottomland	38	1
Mc	Miller clay	17	IIIw-1	Heavy Bottomland	37	3
NbD	Noble fine sandy loam, 3 to 8 percent slopes	18	IVe-3	Sandy Savannah	36	2
NoB	Norge loam, 1 to 3 percent slopes	18	IIe-1	Loamy Prairie	33	2

Map symbol	Mapping unit	Page	Capability unit	Range site		Woodland suitability group
			Symbol	Name	Page	Number
NoC	Norge loam, 3 to 5 percent slopes	18	IIIe-2	Loamy Prairie	33	2
NoC2	Norge loam, 2 to 5 percent slopes, eroded	18	IIIe-5	Loamy Prairie	33	3
Pf	Port clay loam, frequently flooded	19	Vw-4	Loamy Bottomland	38	2
Pc	Port clay loam, occasionally flooded	19	IIw-1	Loamy Bottomland	38	1
Po	Port loam, occasionally flooded	19	IIw-1	Loamy Bottomland	38	1
Ps	Pulaski fine sandy loam	20	IIw-2	Loamy Bottomland	38	1
Pw	Pulaski soils, wet	20	Vw-3	Subirrigated	38	2
ReB	Renfrow silt loam, 1 to 3 percent slopes	21	IIIe-1	Claypan Prairie	33	3
ReC	Renfrow silt loam, 3 to 5 percent slopes	21	IVe-5	Claypan Prairie	33	3
RfC2	Renfrow silty clay loam, 2 to 5 percent slopes, eroded	21	IVe-2	Claypan Prairie	33	4
RvC3	Renfrow-Vernon complex, 2 to 5 percent slopes, severely eroded	21	VIe-1	Eroded Clay	33	4
Rx	Roebuck clay	22	Vw-1	Heavy Bottomland	37	4
StB	Stephenville fine sandy loam, 1 to 3 percent slopes	23	IIe-2	Sandy Savannah	36	2
StC	Stephenville fine sandy loam, 3 to 5 percent slopes	24	IIIe-3	Sandy Savannah	36	2
StC2	Stephenville fine sandy loam, 2 to 5 percent slopes, eroded	24	IIIe-6	Sandy Savannah	36	3
TeB	Teller loam, 1 to 3 percent slopes	24	IIe-1	Loamy Prairie	33	2
TeC	Teller loam, 3 to 5 percent slopes	25	IIIe-2	Loamy Prairie	33	2
TeC2	Teller loam, 2 to 5 percent slopes, eroded	25	IIIe-5	Loamy Prairie	33	3
VaA	Vanoss loam, 0 to 1 percent slopes	25	I-2	Loamy Prairie	33	2
VaB	Vanoss loam, 1 to 3 percent slopes	26	IIe-1	Loamy Prairie	33	2
VaB2	Vanoss loam, 1 to 3 percent slopes, eroded	26	IIIe-5	Loamy Prairie	33	3
VcC	Vernon clay loam, 3 to 5 percent slopes	26	IVe-1	Red Clay Prairie	34	4
VeF	Vernon-Collinsville complex, 5 to 20 percent slopes	26				
	Vernon soil	--	VIIs-1	Red Clay Prairie	34	4
	Collinsville soil	--	VIIs-1	Shallow Prairie	34	4
VlE	Vernon-Lucien complex, 5 to 15 percent slopes	27				
	Vernon soil	--	VIe-4	Red Clay Prairie	34	4
	Lucien soil	--	VIe-4	Shallow Prairie	34	4
We	Wet alluvial land	27	VIIw-1	Wetland	38	3
Yc	Yahola clay loam	28	IIw-1	Loamy Bottomland	38	1
Yf	Yahola fine sandy loam	28	IIw-2	Loamy Bottomland	38	1
ZaC	Zaneis loam, 3 to 5 percent slopes	28	IIIe-2	Loamy Prairie	33	2
ZaC2	Zaneis loam, 3 to 5 percent slopes, eroded	29	IIIe-5	Loamy Prairie	33	3

331-682 O (Face O. P. Maps)


PAYNE COUNTY
R. 2 E.
1
LOGAN COUNTY
T. 17 N.
N
Walnut Creek
Corduroy Creek
19
20
21
22
27
28
29
30
31
32
33
34
(Joins sheet 2)
(Joins sheet 9)
0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

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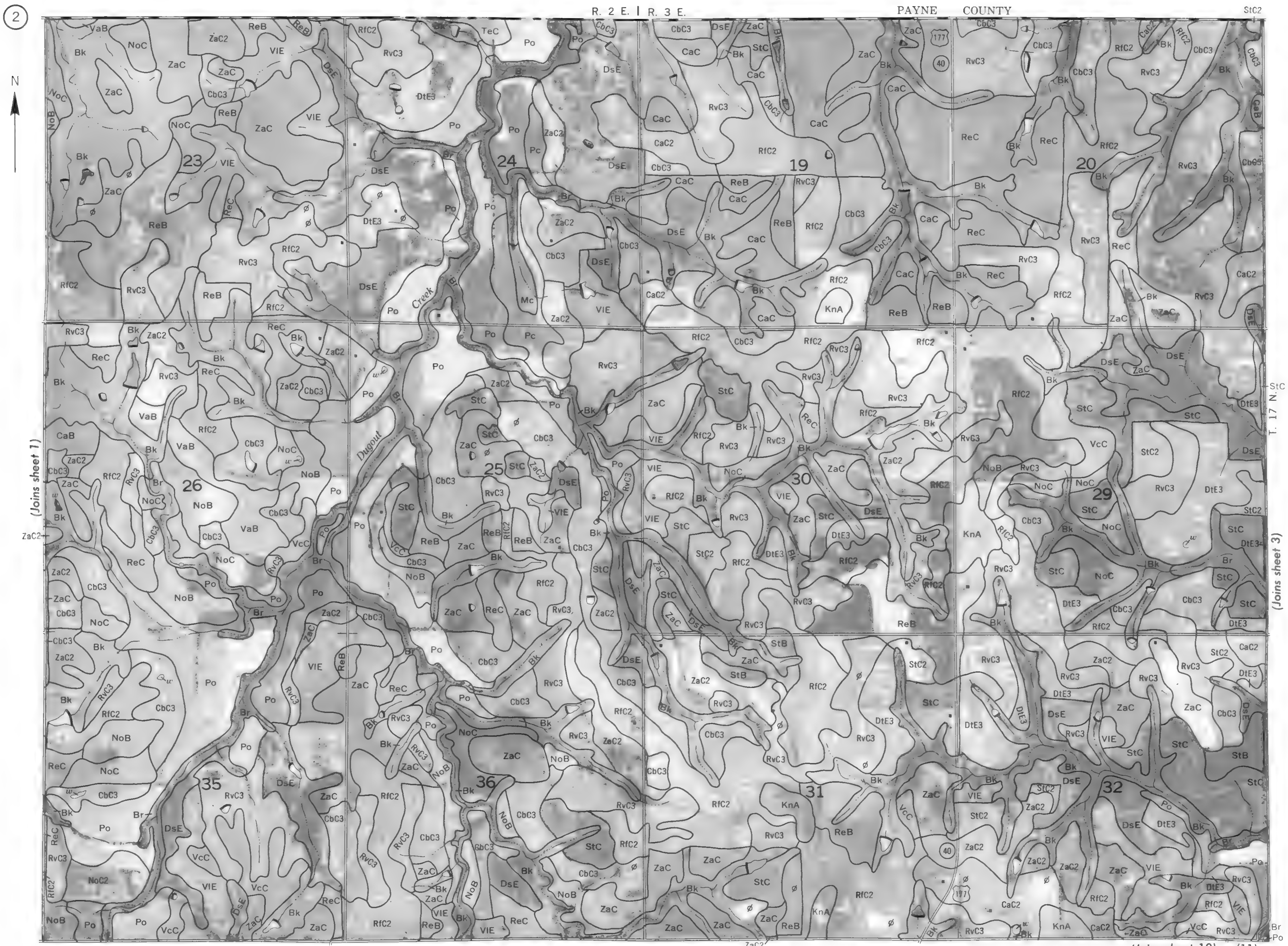

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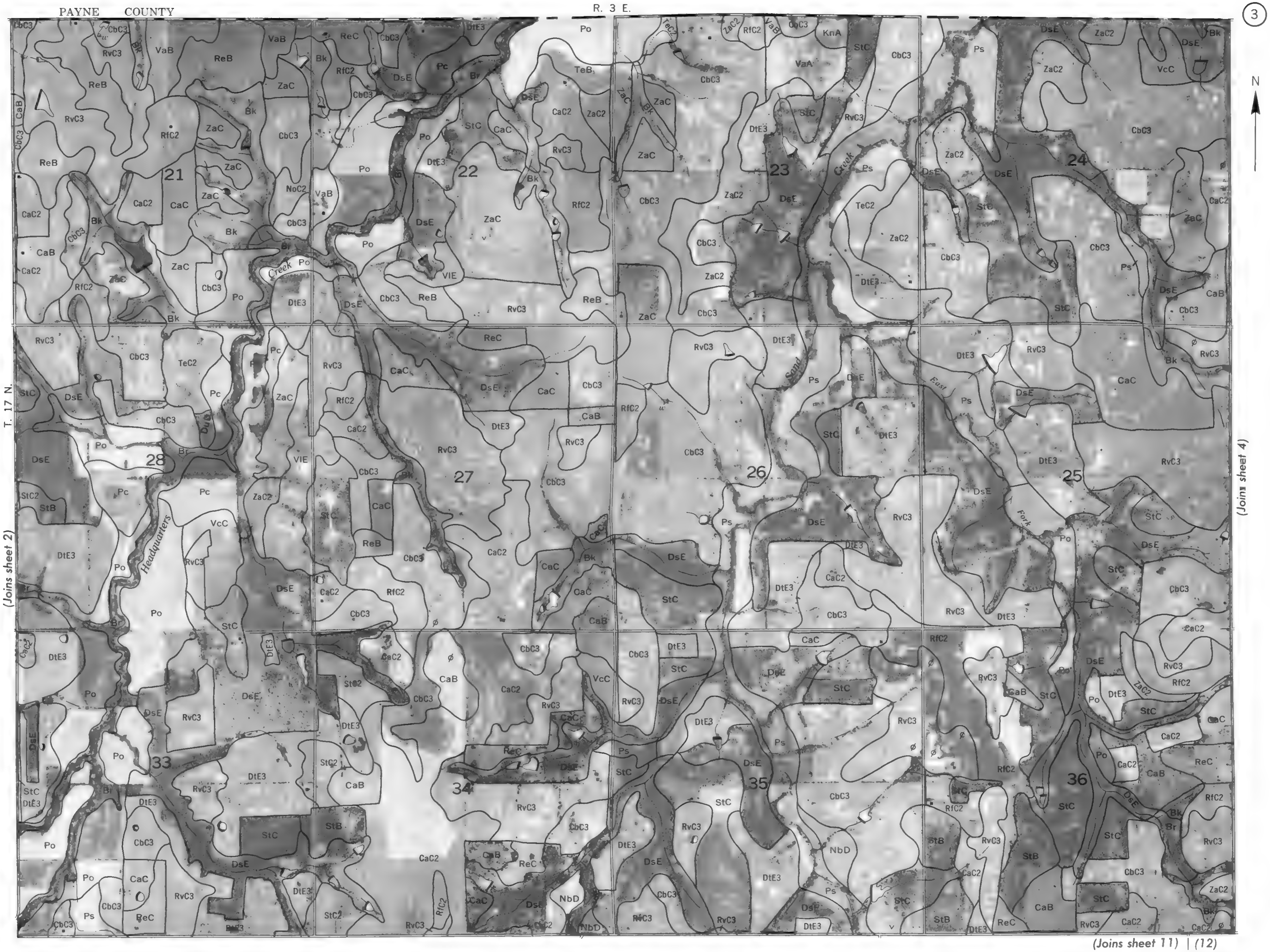
LINCOLN COUNTY, OKLAHOMA NO. 2

3

LINCOLN COUNTY, OKLAHOMA NO. 3



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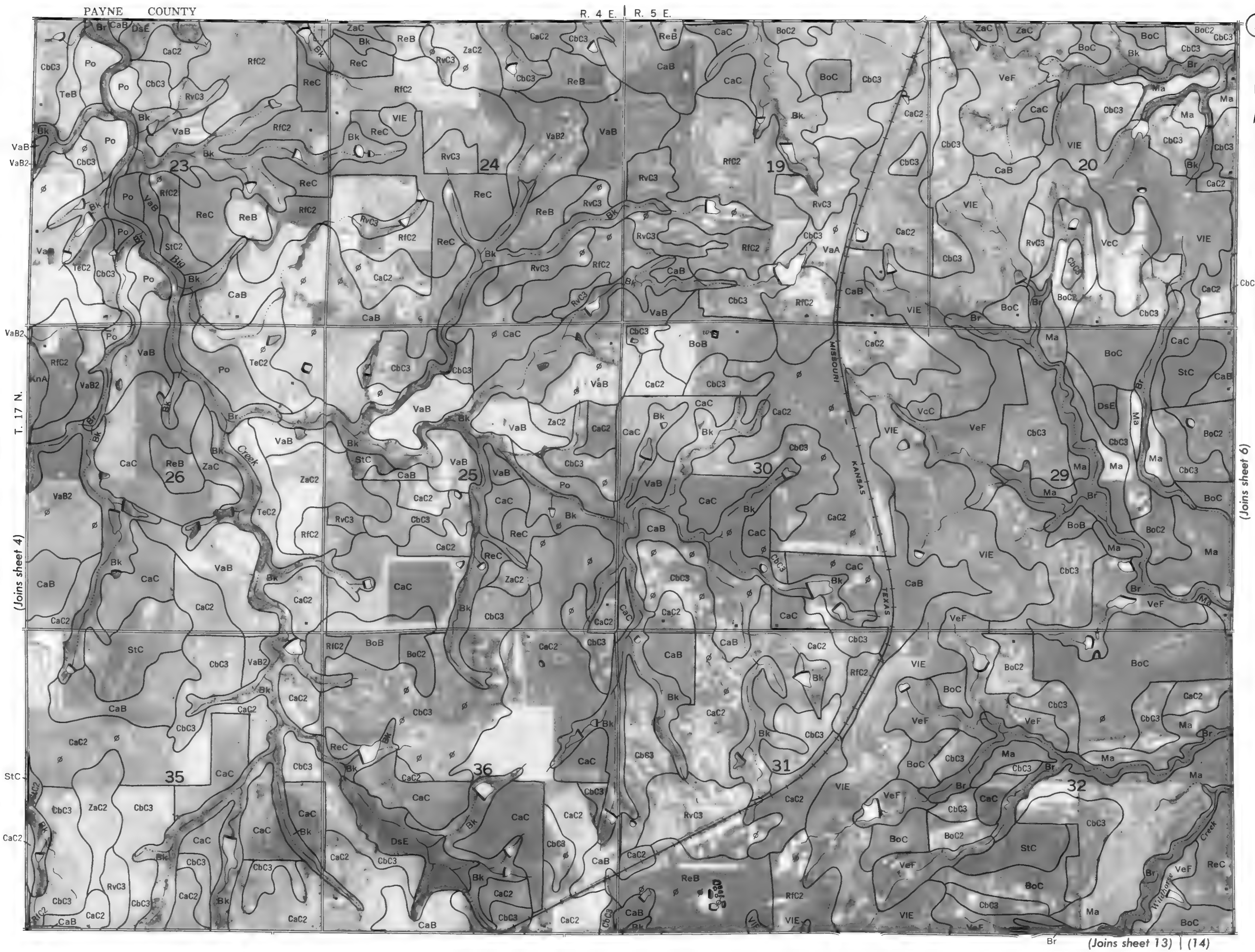
4

0 ½ 1 Mile

Scale 1:20 000

0 5 000 Feet



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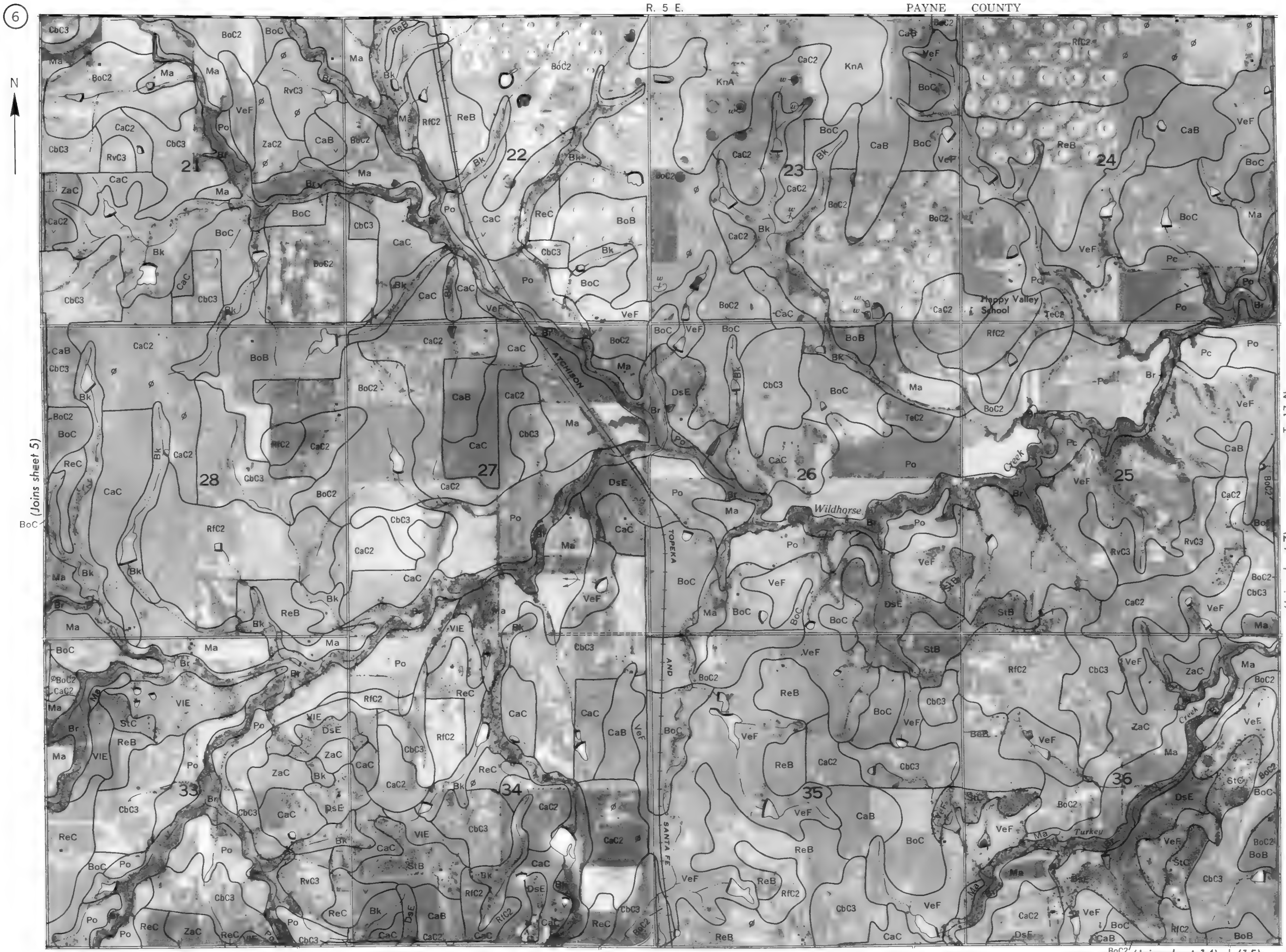

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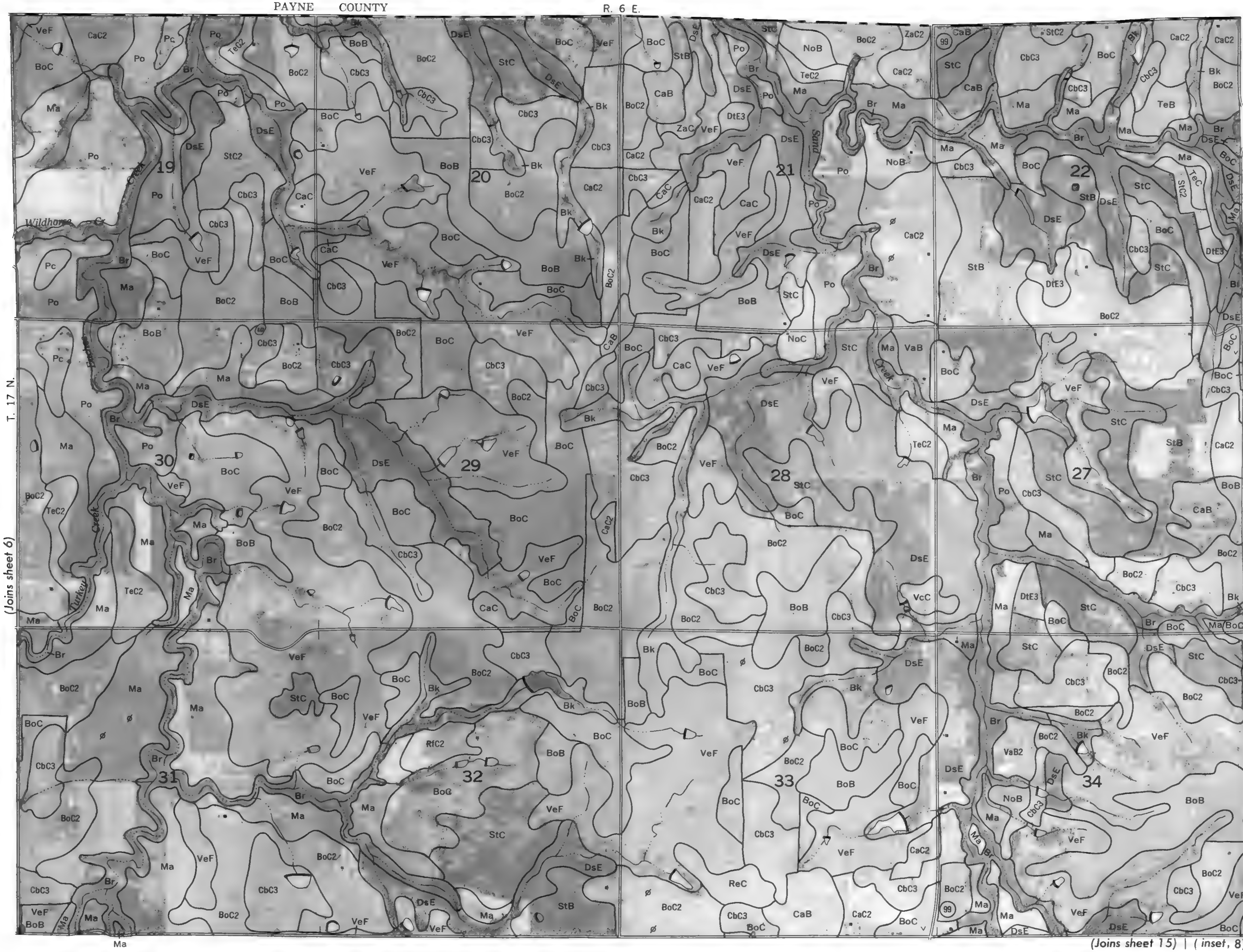

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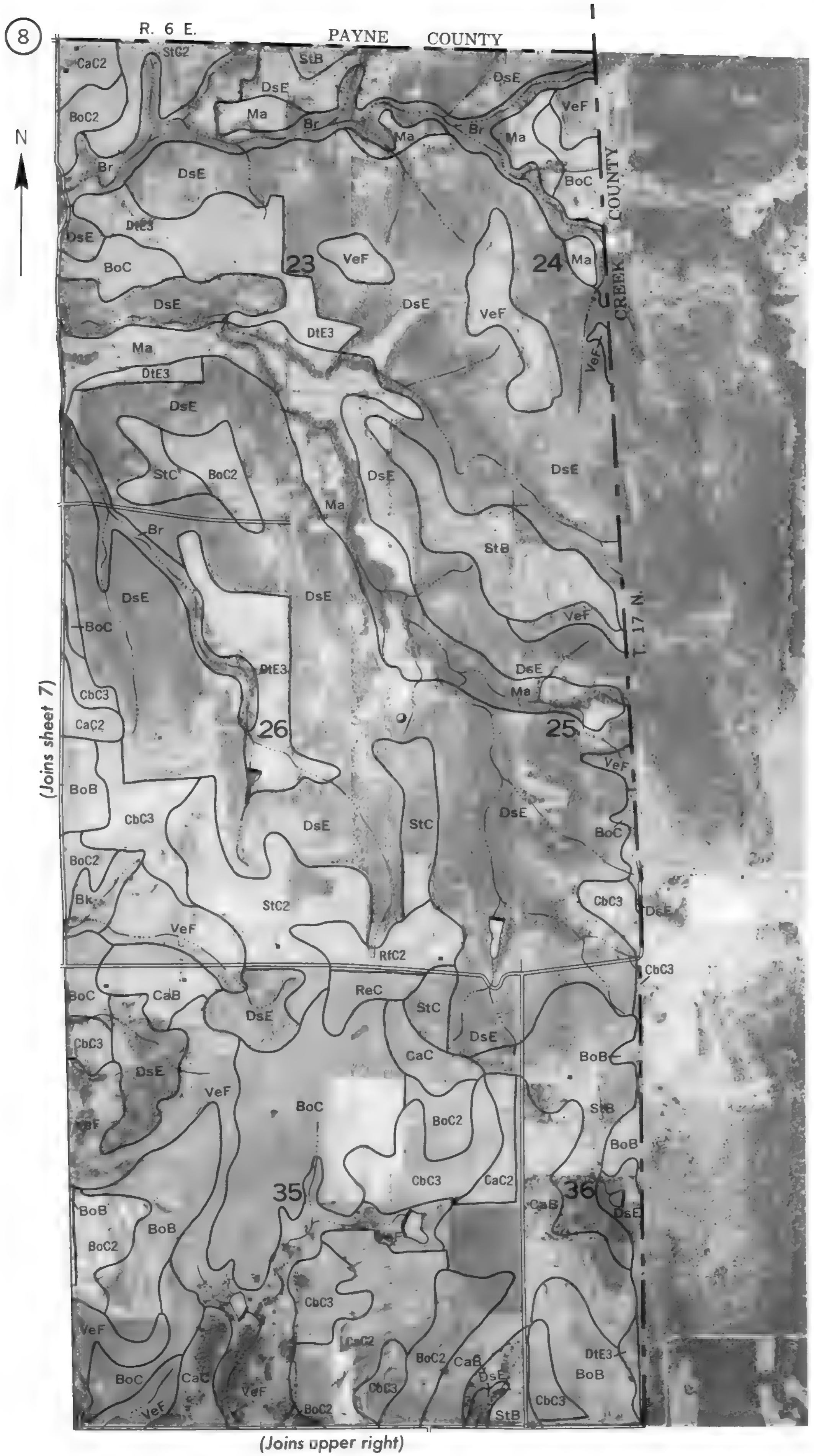

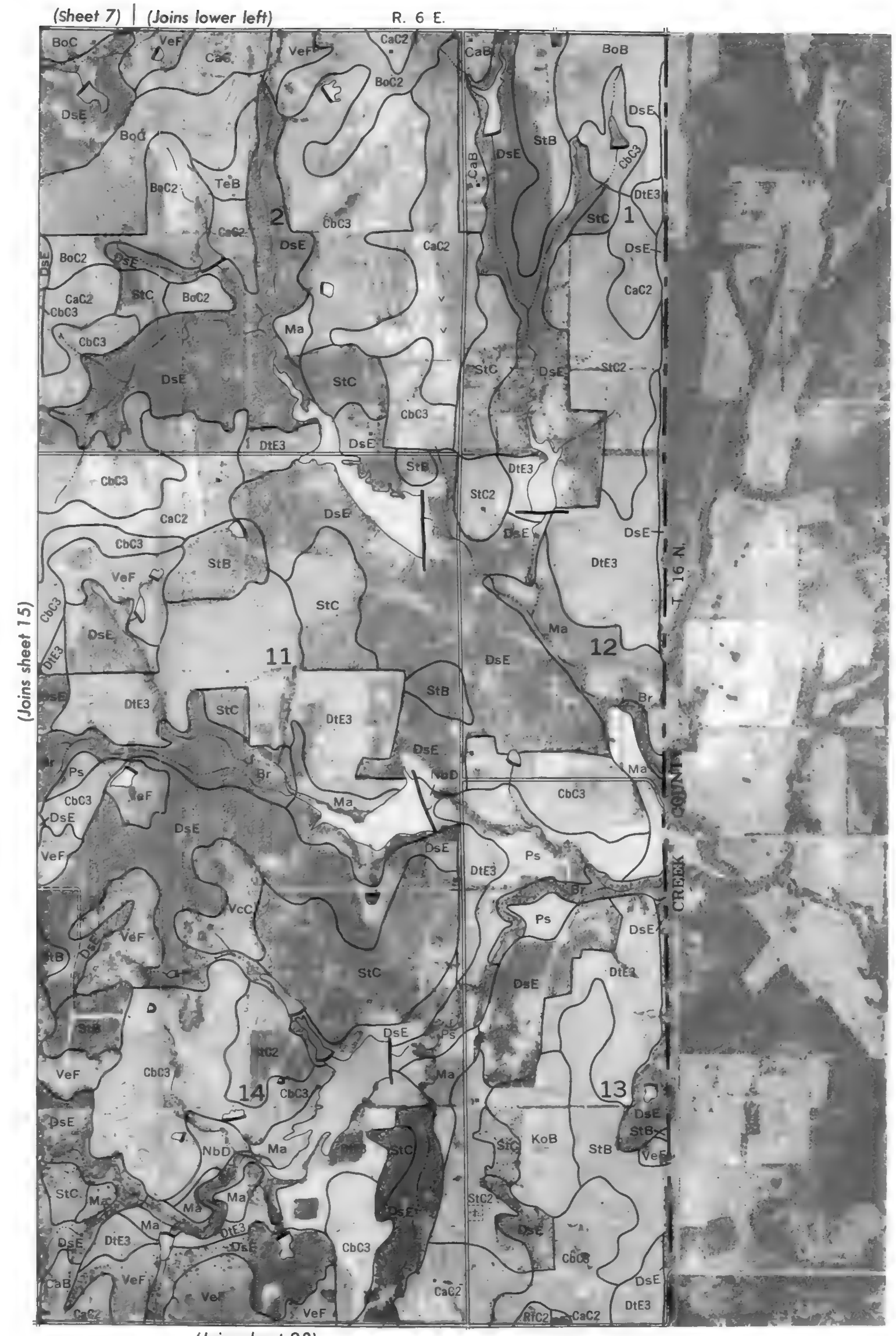

0 ½ 1 Mile

Scale 1:20 000

0 5 000 Feet

(Joins sheet 1)

9

(Joins sheet 16)

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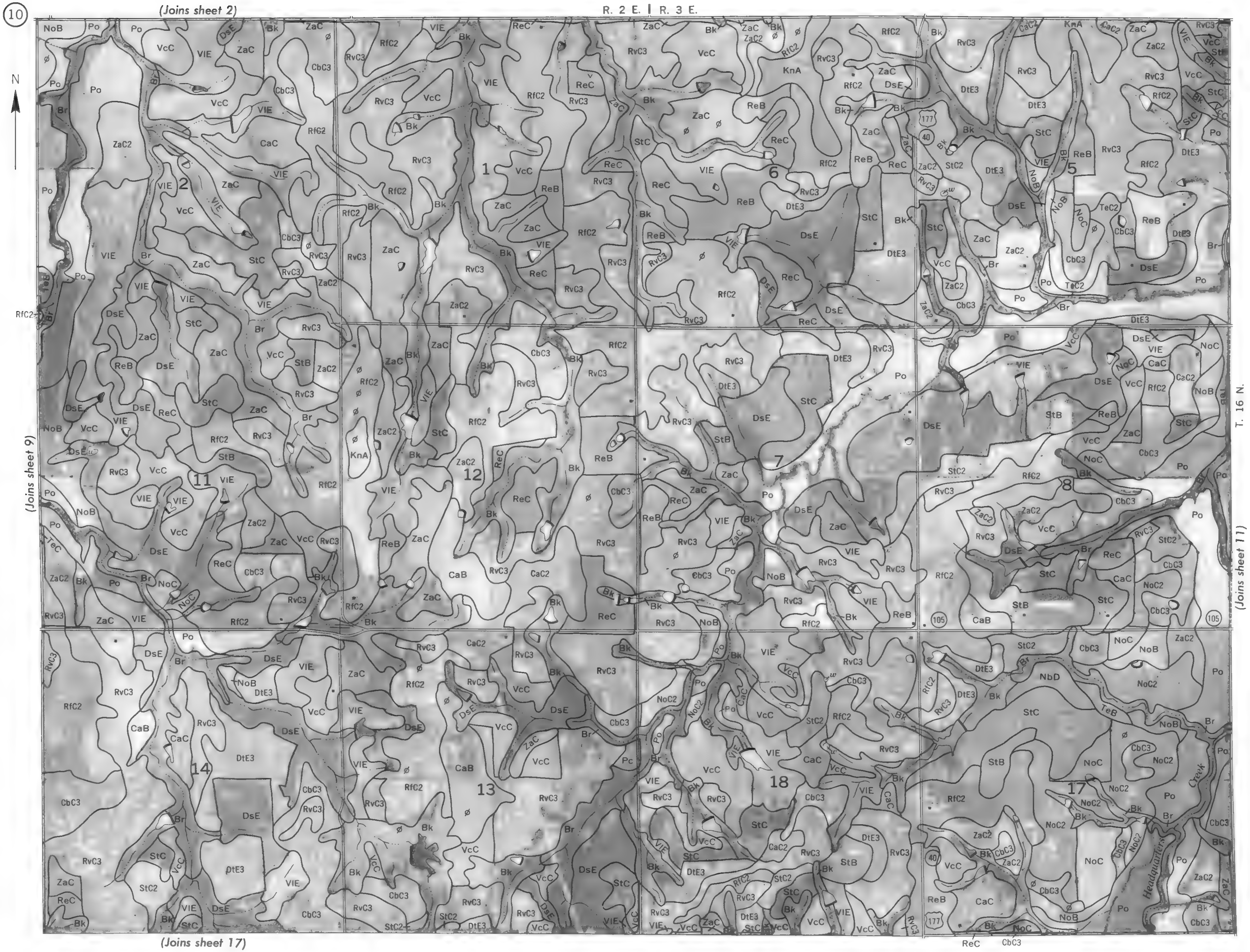

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet


(2) | (Joins sheet 3)
R. 3 E.
N
T. 16 N.
(Joins sheet 10)
(Joins sheet 12)
(Joins sheet 18)
Headquarters Creek
ODD FELLOWS CEMETERY
Tryon
MISSOURI KANSAS — TEXAS
105
1
2
3
4
9
10
11
12
13
14
15
16
0
½
1 Mile
Scale 1:20 000
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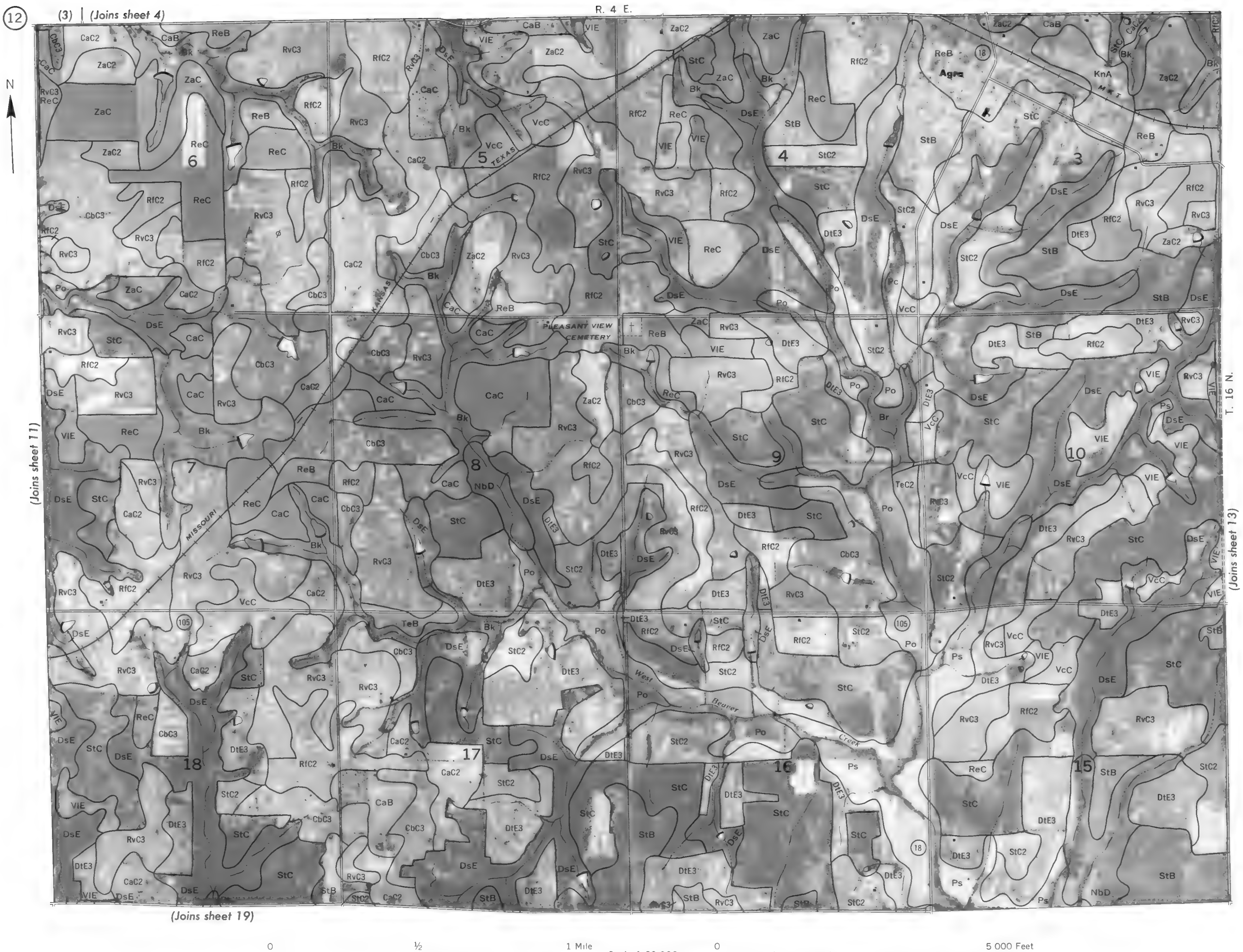
5 000 Feet



12
(3) | (Joins sheet 4)
R. 4 E.
N
(Joins sheet 11)
(Joins sheet 13)
T. 16 N.
(Joins sheet 19)
Agra
PLEASANT VIEW CEMETERY
KANSAS
MISSOURI
TEXAS
M K T
West Beaver Creek
18
105
6
5
4
3
7
8
9
10
18
17
16
15
0
½
1 Mile
Scale 1:20 000
0
5 000 Feet

(4) | (Joins sheet 5)

R. 4 E. | R. 5 E.

(13)

T. 16 N.

(Joins sheet 12)

(Joins sheet 14)

(Joins sheet 20)

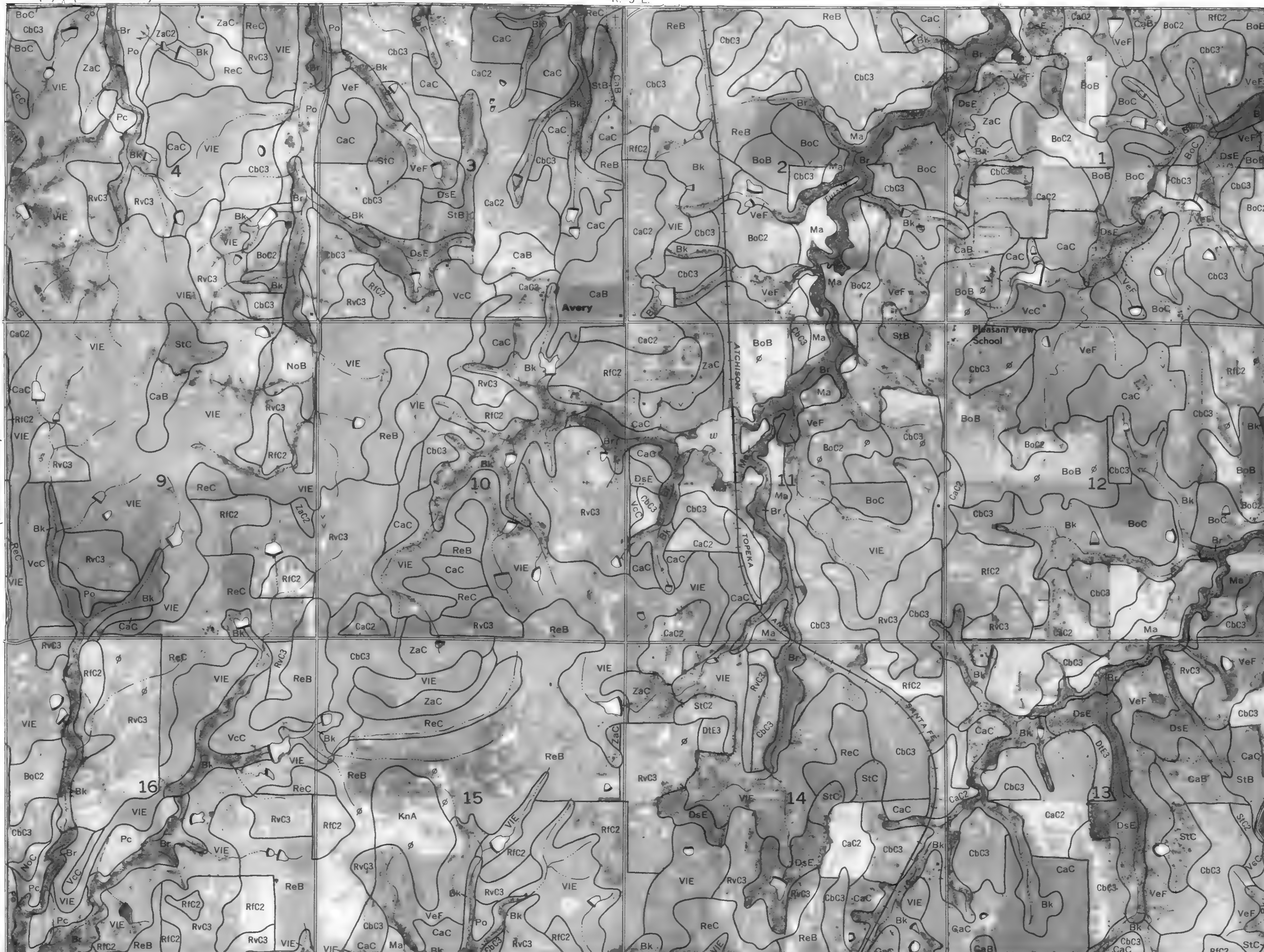
0 ½ 1 Mile

Scale 1:20 000

0 5 000 Feet

(14)

(5) | (Joins sheet 6)



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(Joins sheet 15)

(Joins sheet 21)

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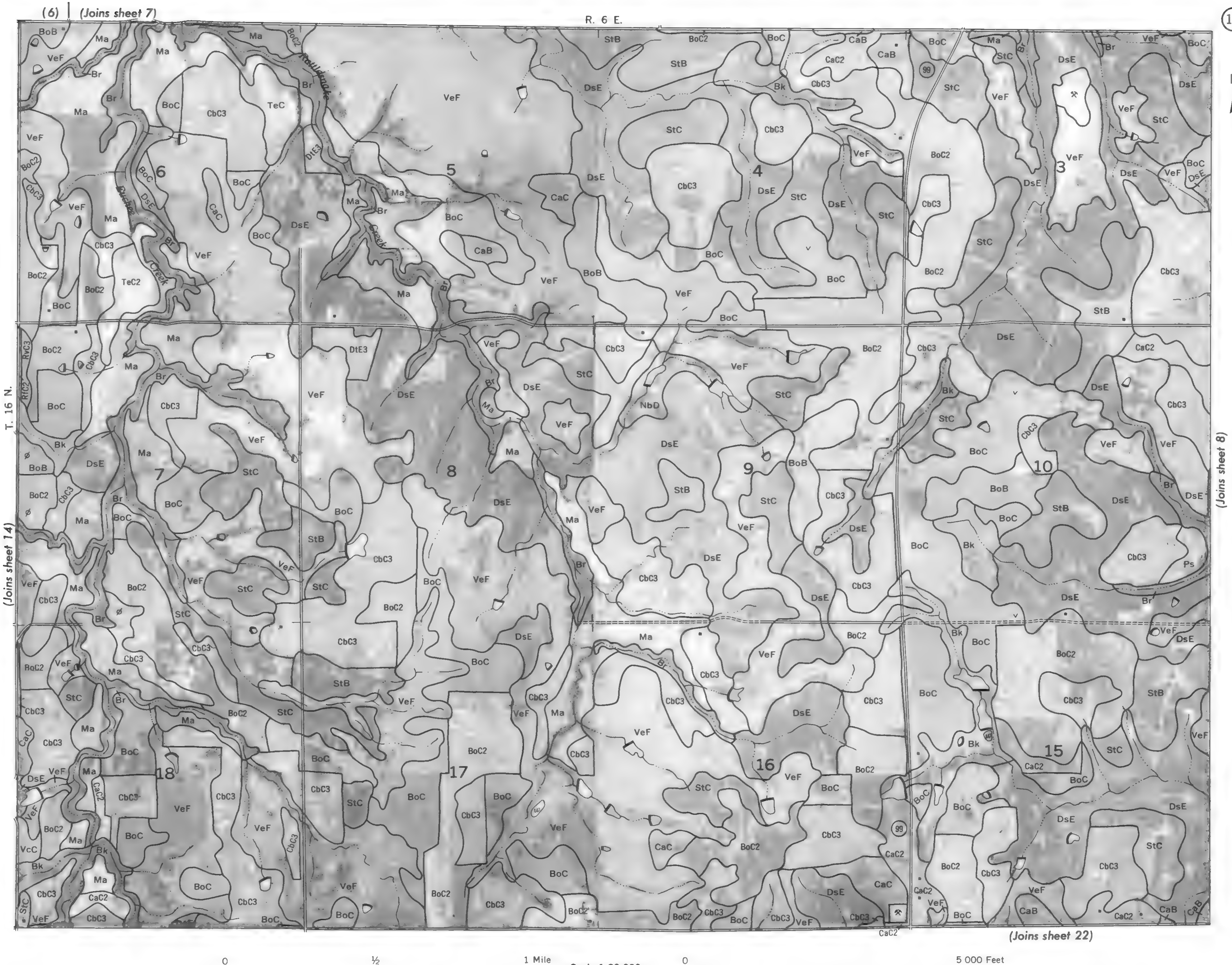
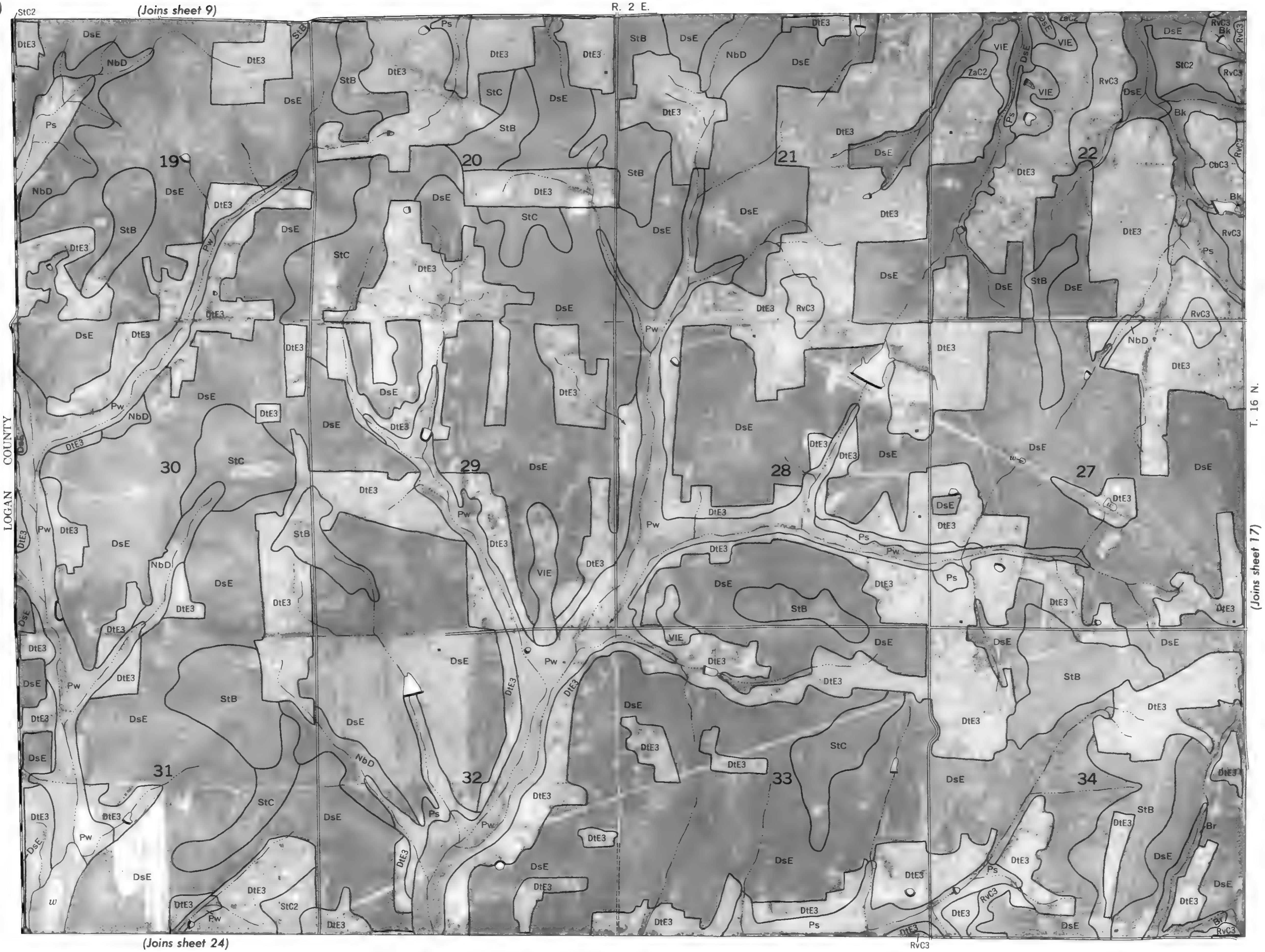


LINCOLN COUNTY, OKLAHOMA NO. 15

16



0 ½ 1 Mile

Scale 1:20 000

0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 16

R. 2 E. | R. 3 E.

(Joins sheet 10)

(17)

(Joins sheet 16)

(Joins sheet 18)

(Joins sheet 25)

0 ½ 1 Mile

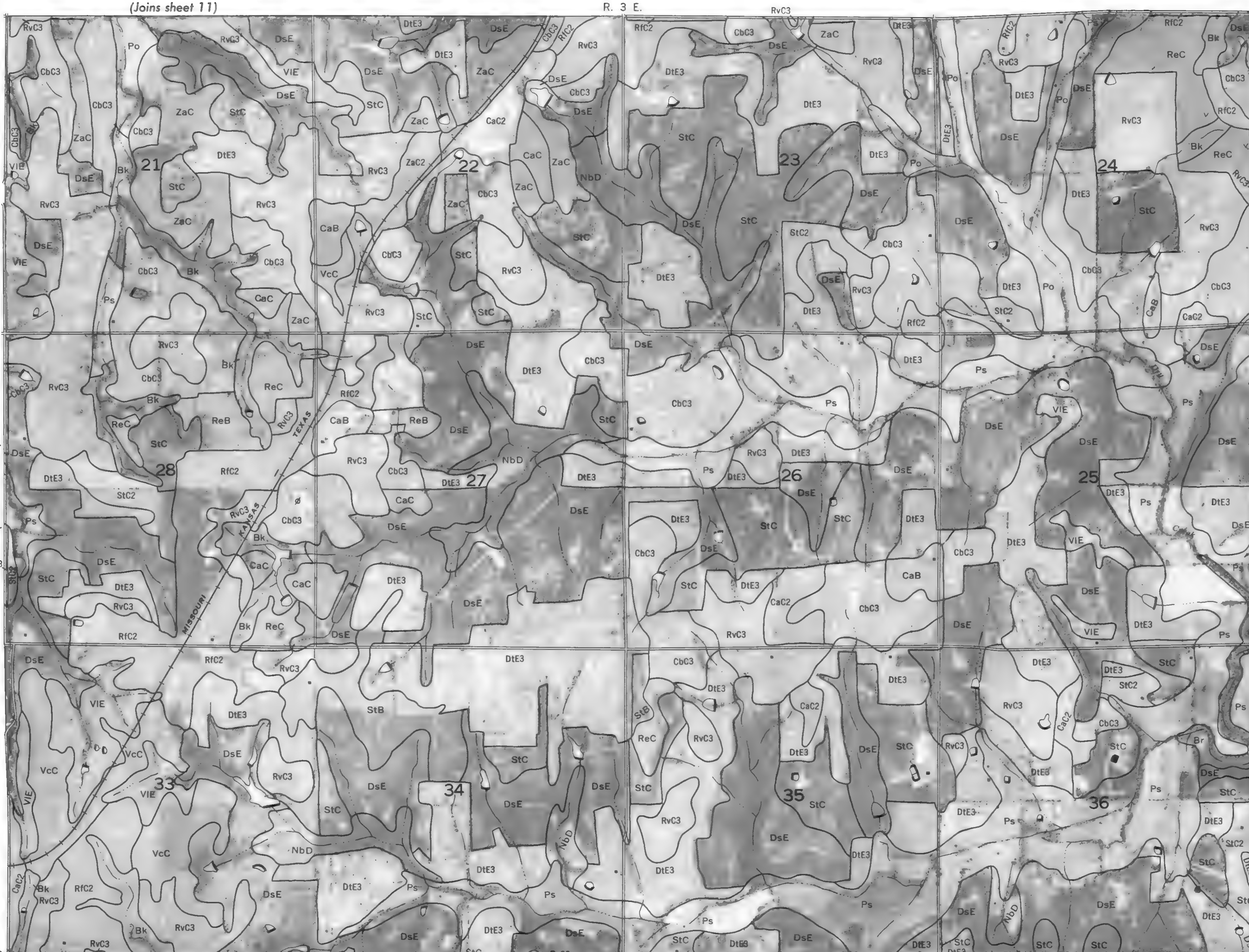
Scale 1:20 000

0 5 000 Feet

18

(Joins sheet 11)

R. 3 E.



(Joins sheet 17)

T. 16 N.

(Joins sheet 19)

(Joins sheet 26)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

(19)

LINCOLN COUNTY, OKLAHOMA NO. 19

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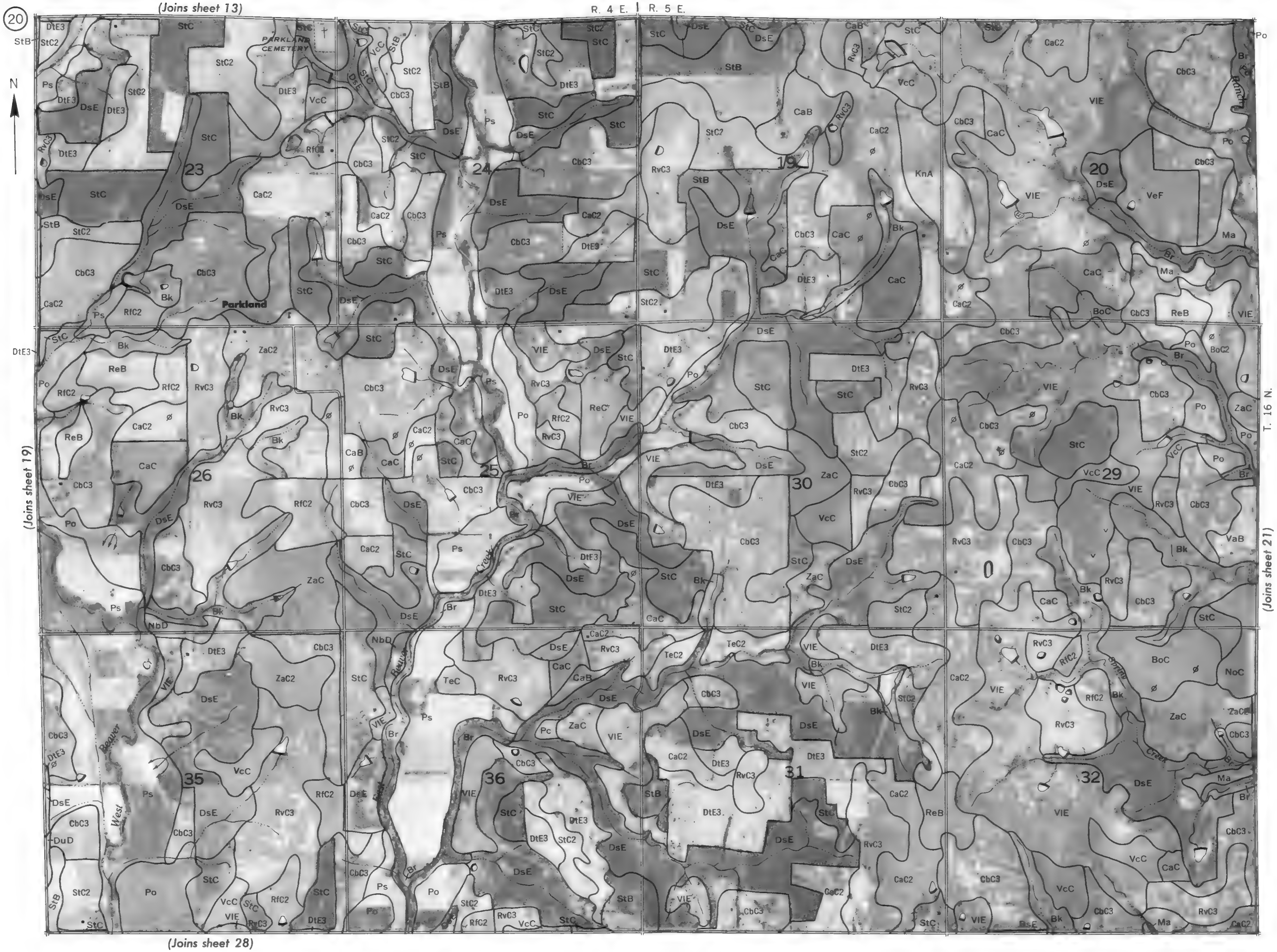

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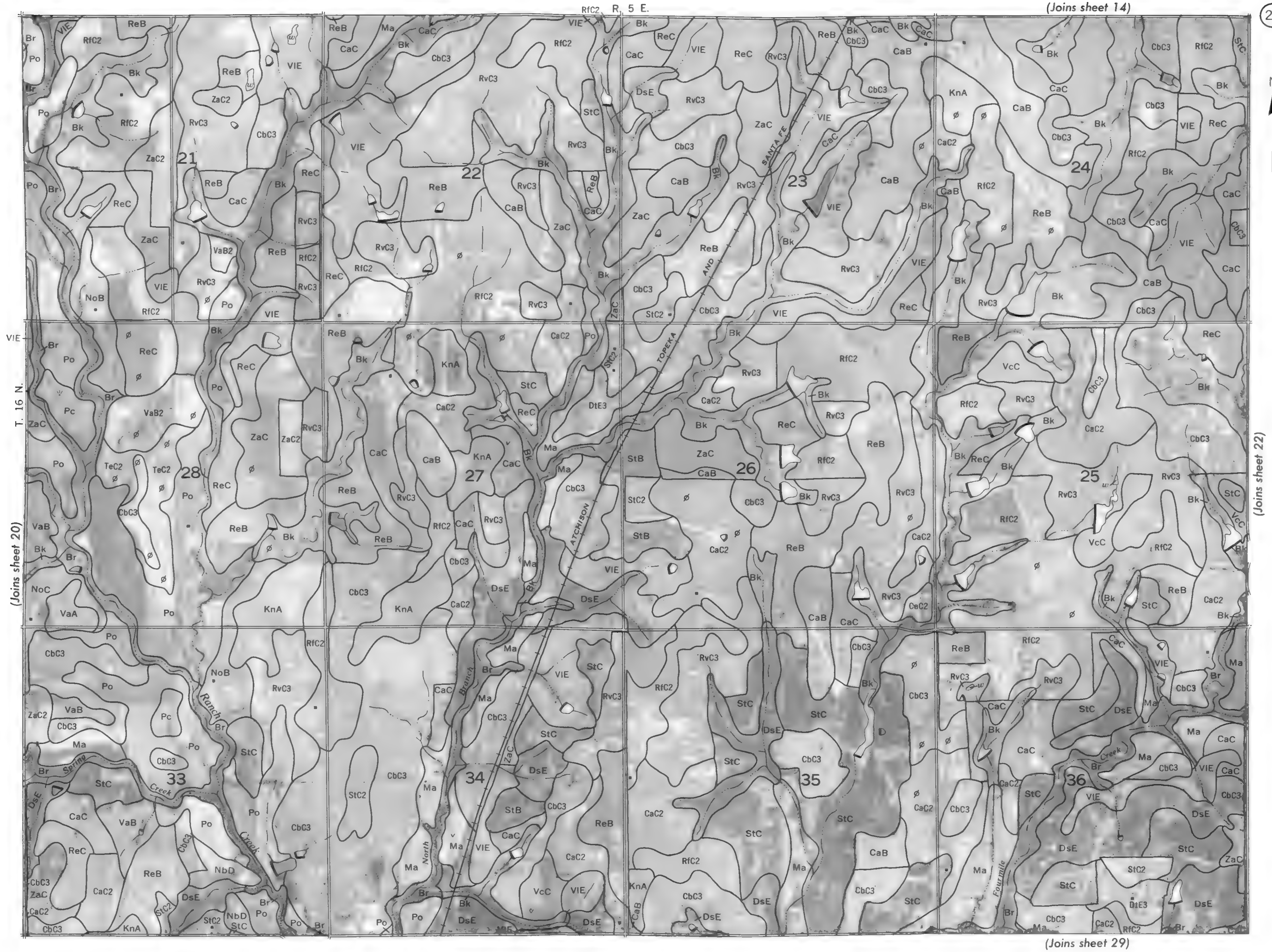

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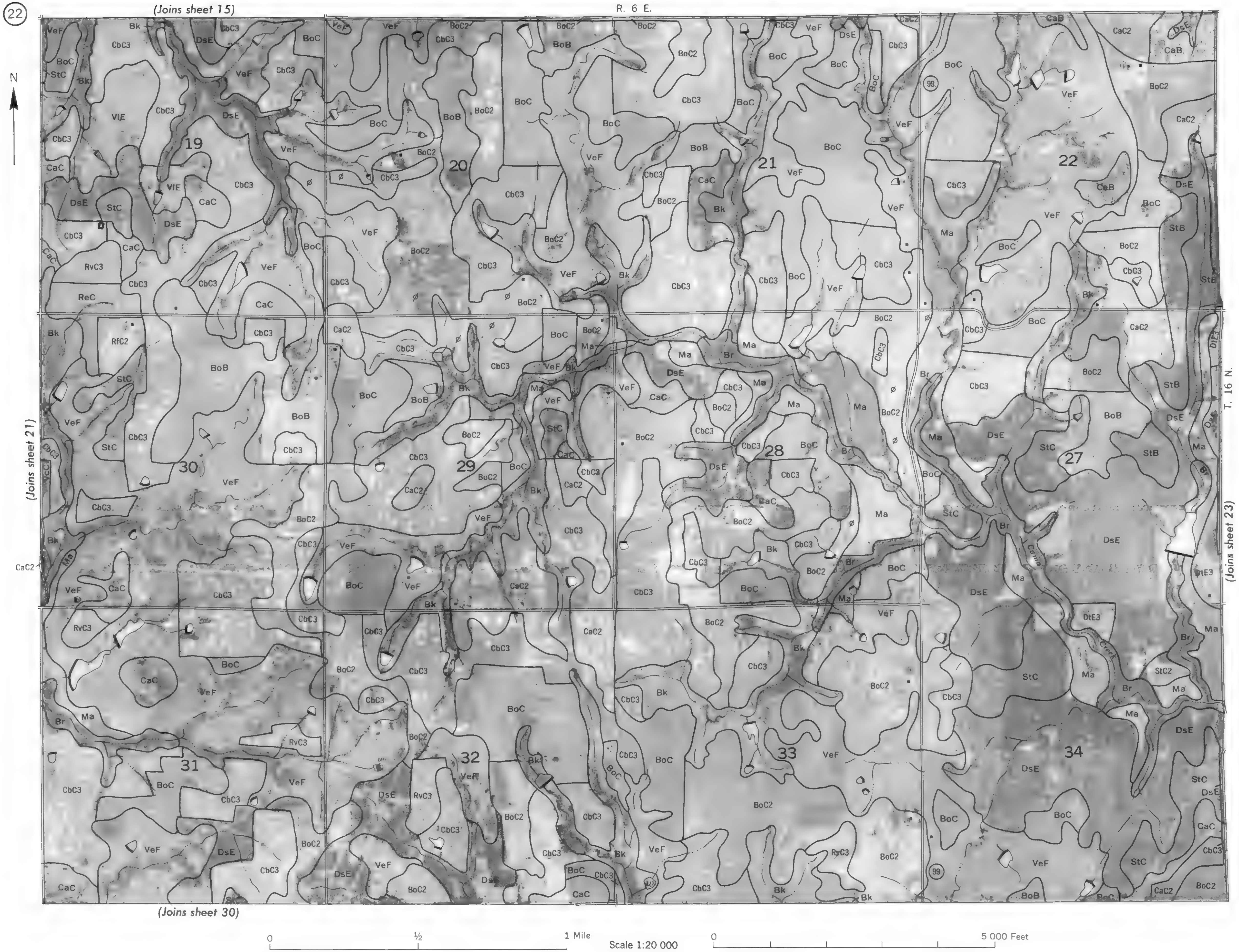
22
(Joins sheet 15)
R. 6 E.
N
(Joins sheet 21)
(Joins sheet 23)
T. 16 N.
(Joins sheet 30)
19
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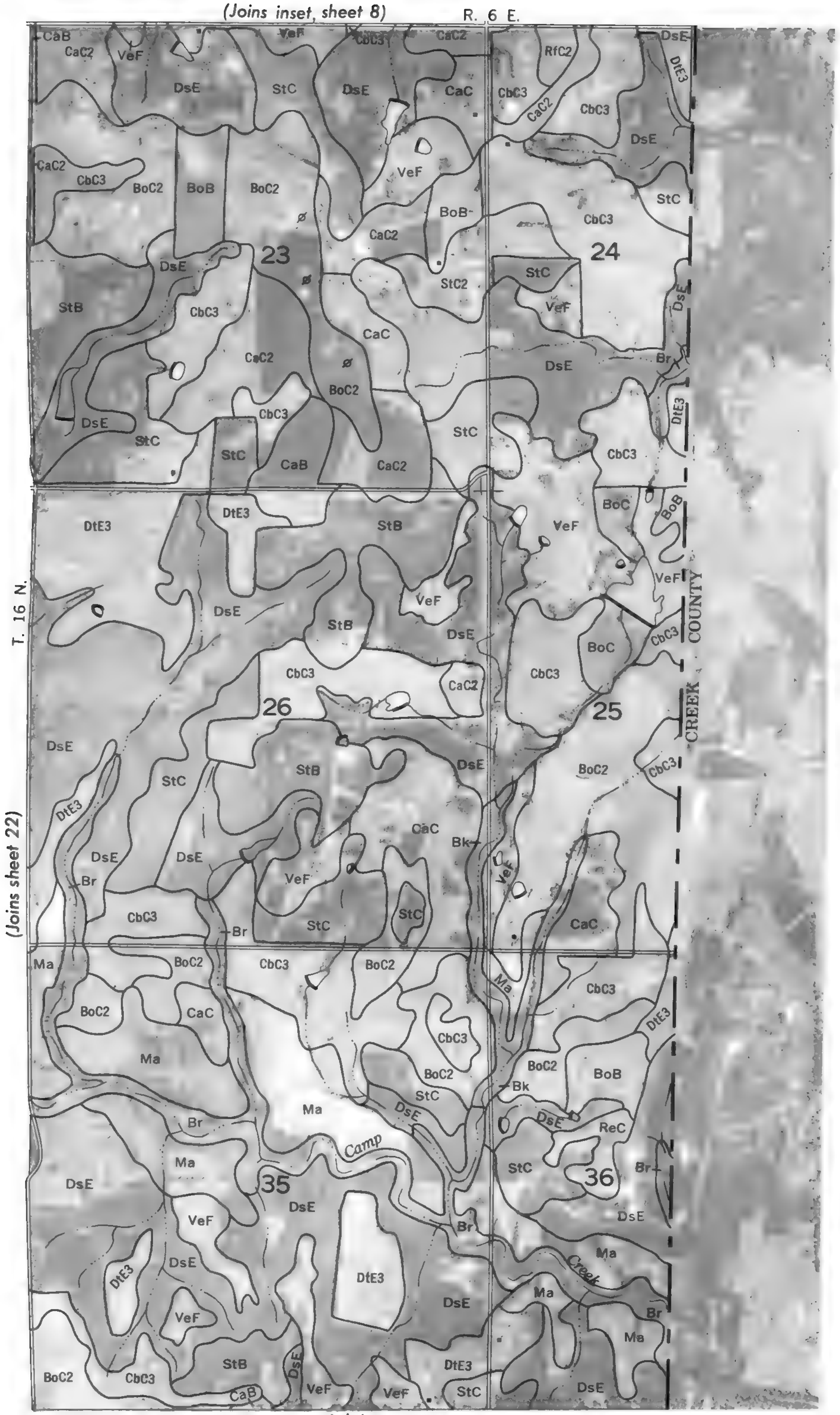
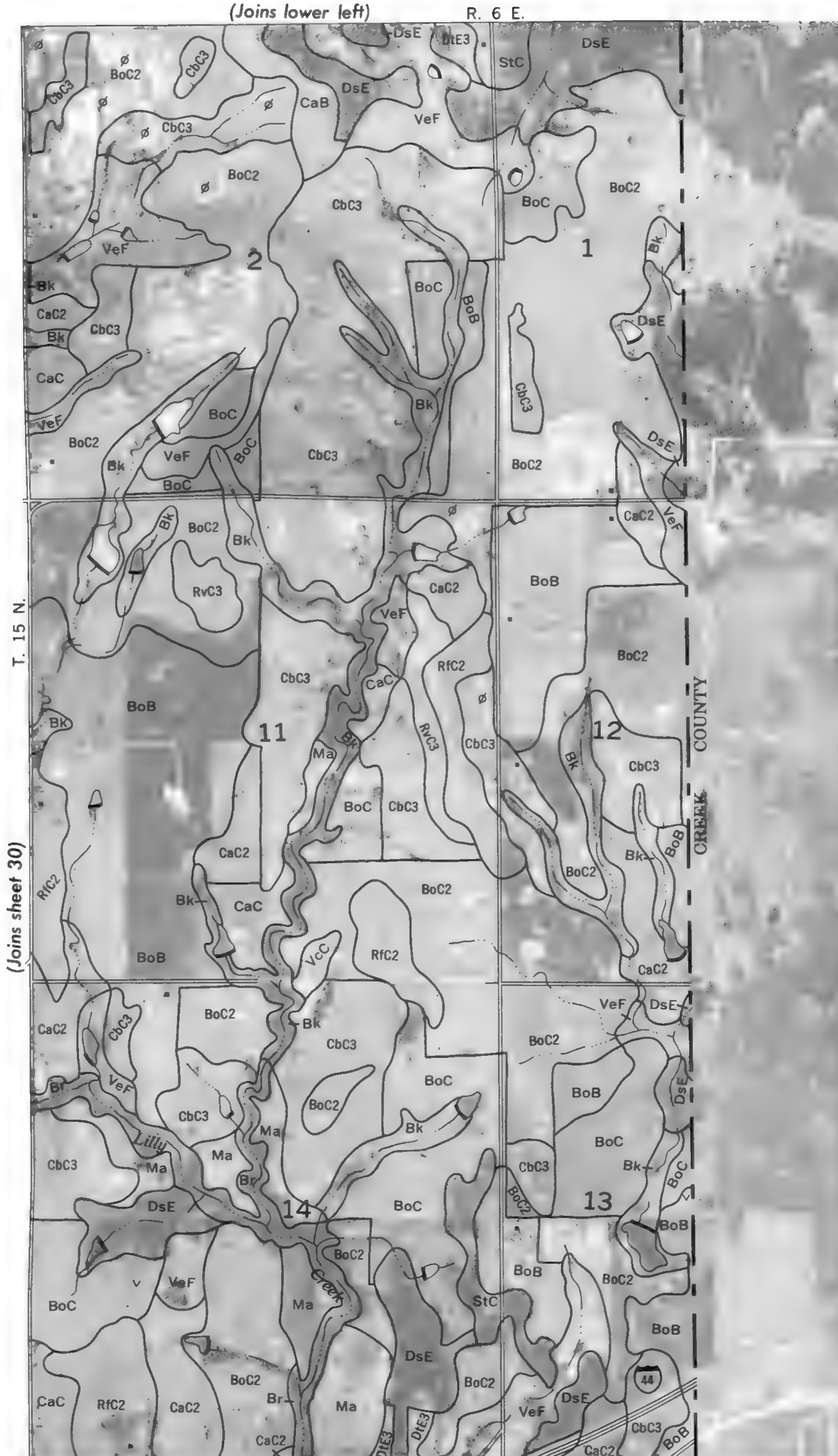
28
27
31
32
33
34
99
Canny Creek
0
½
1 Mile
Scale 1:20 000
0
5 000 Feet





N

0 ½ 1 Mile

Scale 1:20 000

0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 24

(Joins sheet 17)

R. 2 E. | R. 3 E.

25

(Joins sheet 24)

(Joins sheet 26)

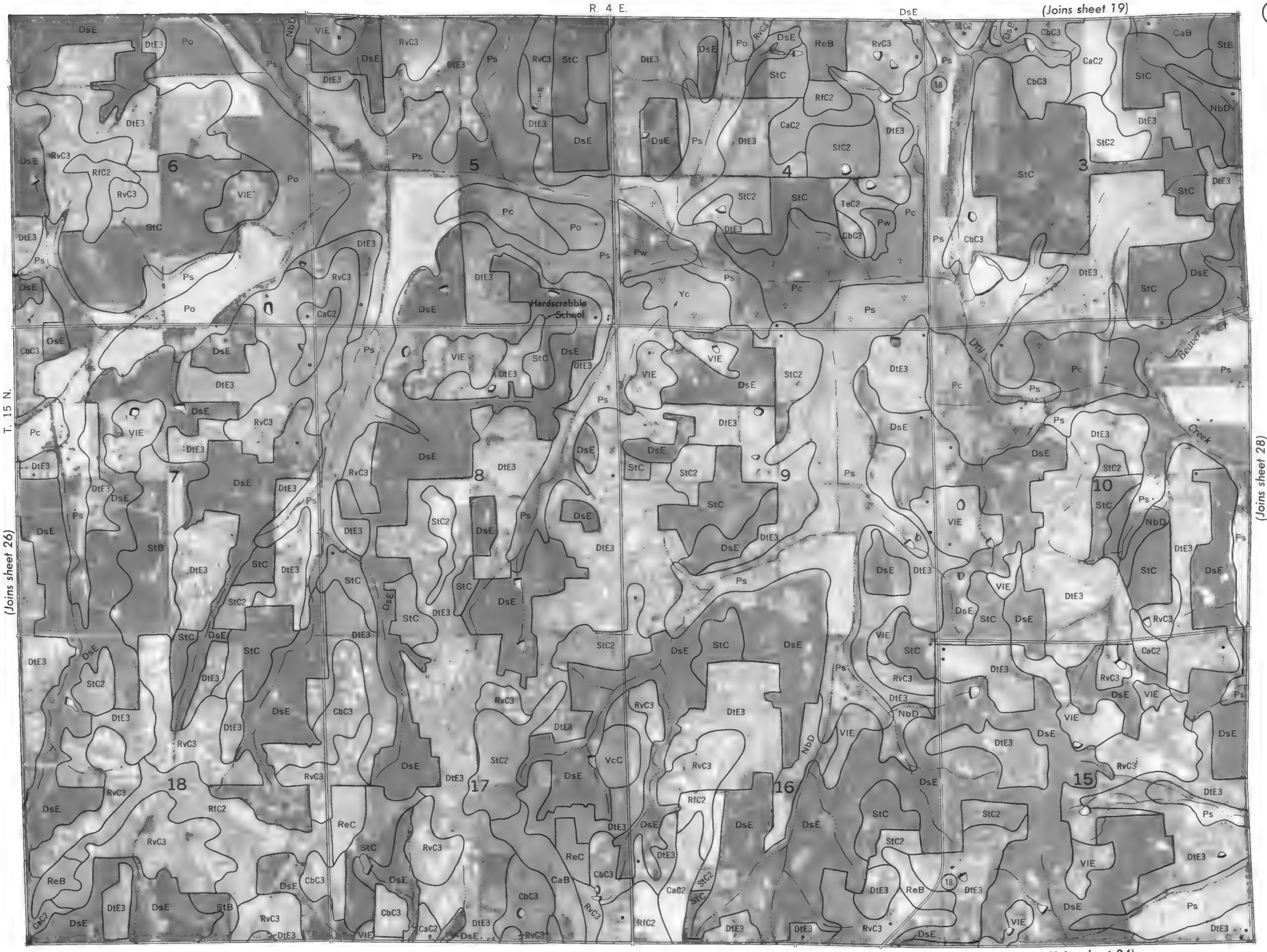
(Joins sheet 32)

0 ½ 1 Mile

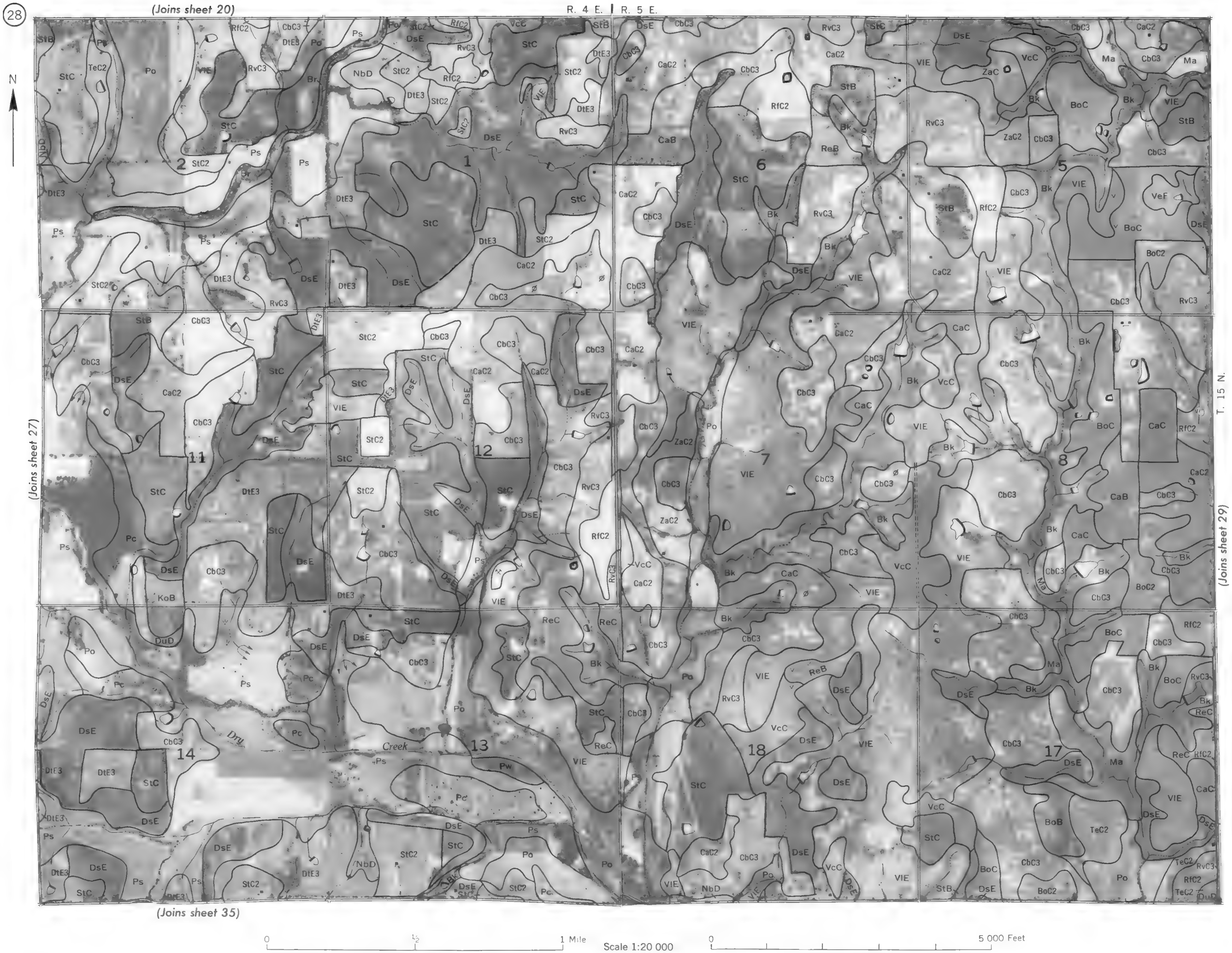
Scale 1:20 000

0 5 000 Feet

26
(Joins sheet 18)
R. 3 E.
N
(Joins sheet 25)
(Joins sheet 27)
T. 15 N.
(Joins sheet 33)
1
2
3
4
9
10
11
12
13
14
15
16
North
Bellcow
Creek
PLEASANT RIDGE CEMETERY
0
½
1 Mile
Scale 1:20 000
0
5 000 Feet

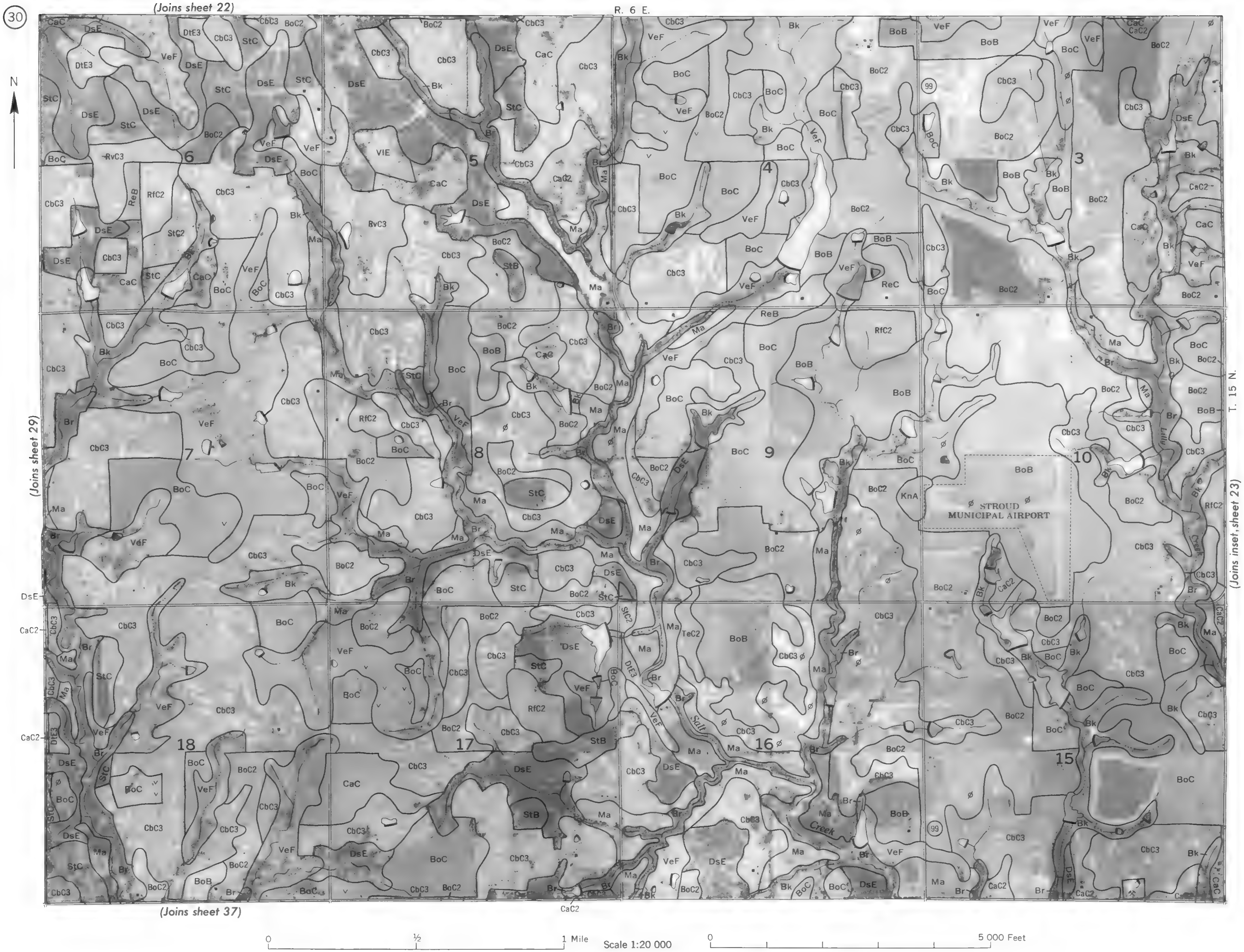


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet


28
(Joins sheet 20)
R. 4 E. | R. 5 E.
N
(Joins sheet 27)
(Joins sheet 29)
T. 15 N.
(Joins sheet 35)
Dry Creek
0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

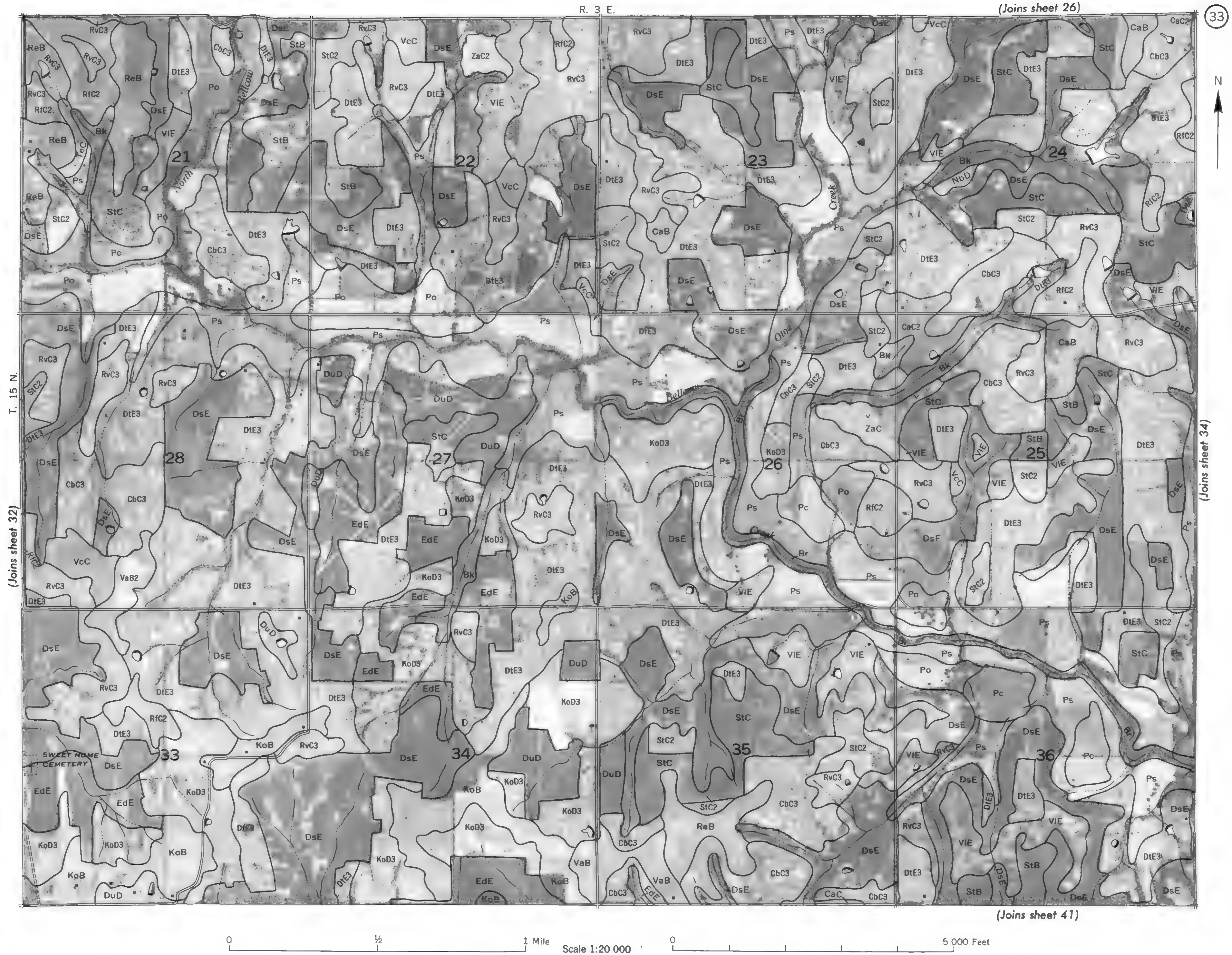
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 29


30
(Joins sheet 22)
R. 6 E.
T. 15 N.
(Joins sheet 29)
(Joins inset, sheet 23)
(Joins sheet 37)
STROUD MUNICIPAL AIRPORT
Salt Creek
0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

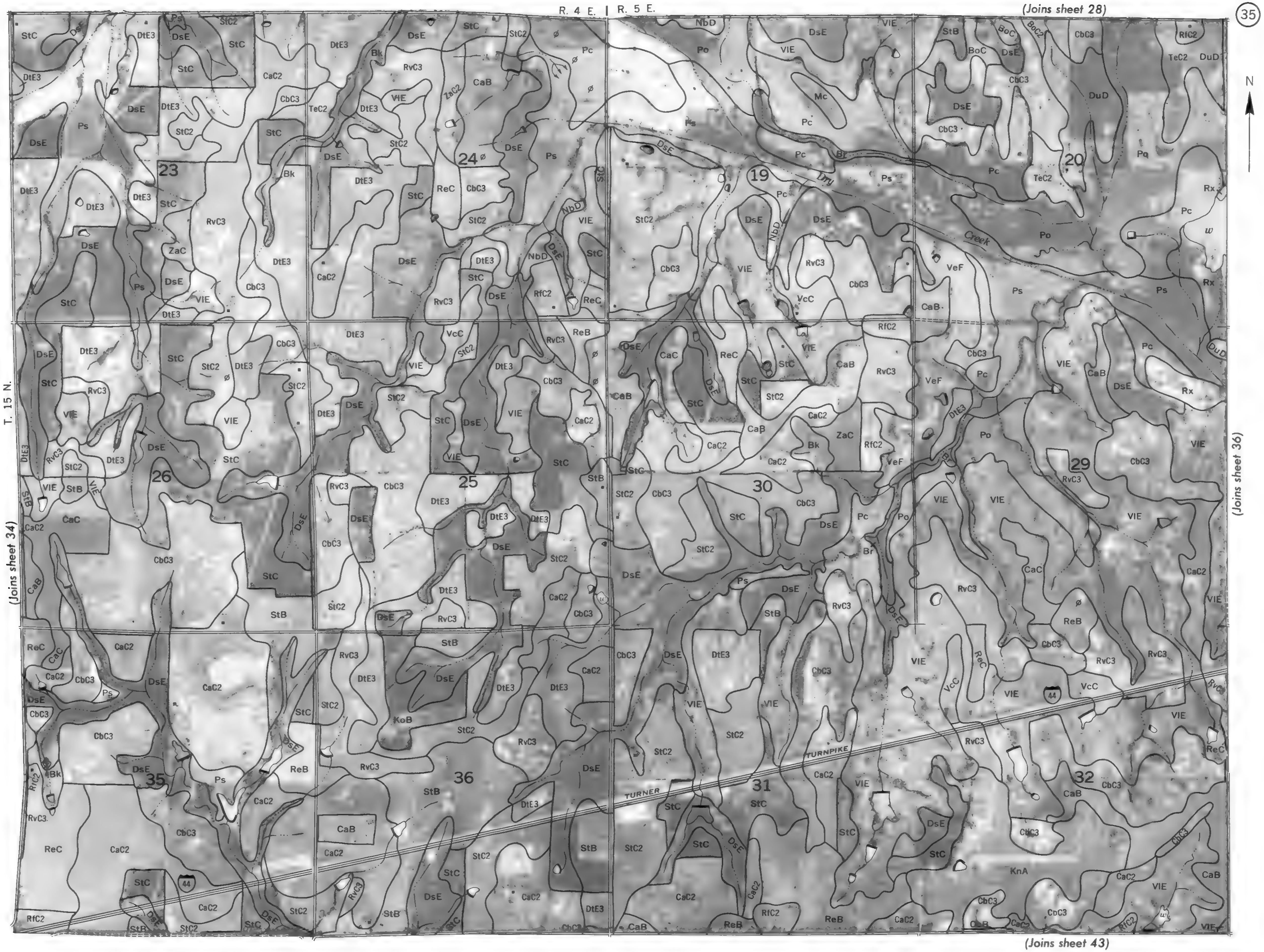
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet


33
R. 3 E.
T. 15 N.
(Joins sheet 26)
(Joins sheet 34)
(Joins sheet 41)
(Joins sheet 32)
N
21
22
23
24
28
27
26
25
33
34
35
36
North Bellcow
Bellcow
Creek
Otoe
Creek
SWEET HOME CEMETERY
0
½
1 Mile
Scale 1:20 000
0
5 000 Feet

34


(Joins sheet 27)
R. 4 E.
N
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 42)
T. 15 N.
19
20
21
22
30
29
28
27
31
32
33
34
CHANDLER CITY LAKE
Bellcow Creek
0
½
1 Mile
Scale 1:20 000
0
5 000 Feet



0 ½ 1 Mile

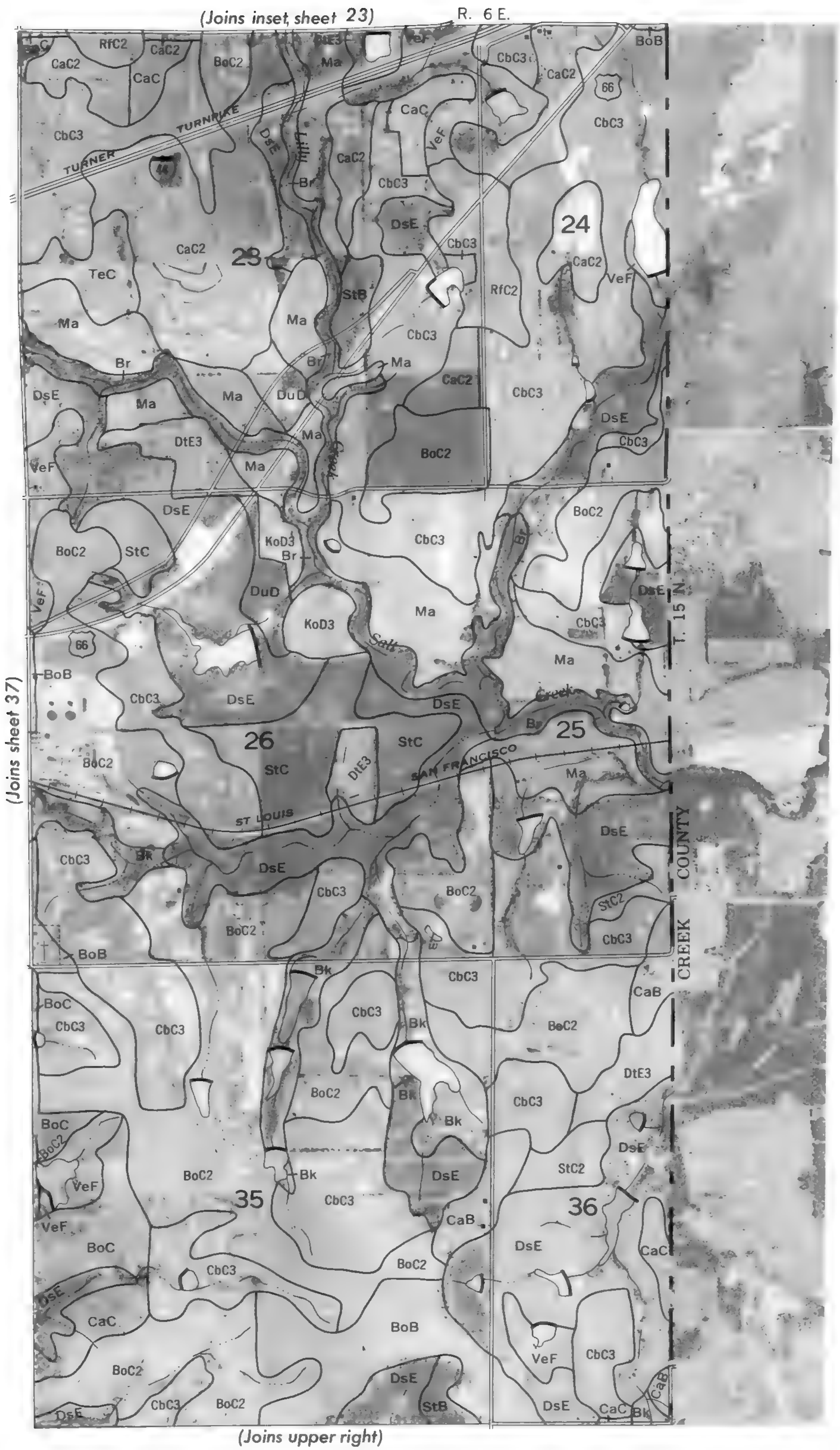
Scale 1:20 000

0 5 000 Feet


36
(Joins sheet 29)
R. 5 E.
N
(Joins sheet 35)
(Joins sheet 37)
T. 15 N.
(Joins sheet 44)
ATCHISON TOPEKA AND SANTA FE
TURNER TURNPIKE
water
21
22
23
24
25
26
27
28
33
34
35
36
0
½
1 Mile
Scale 1:20 000
0
5 000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

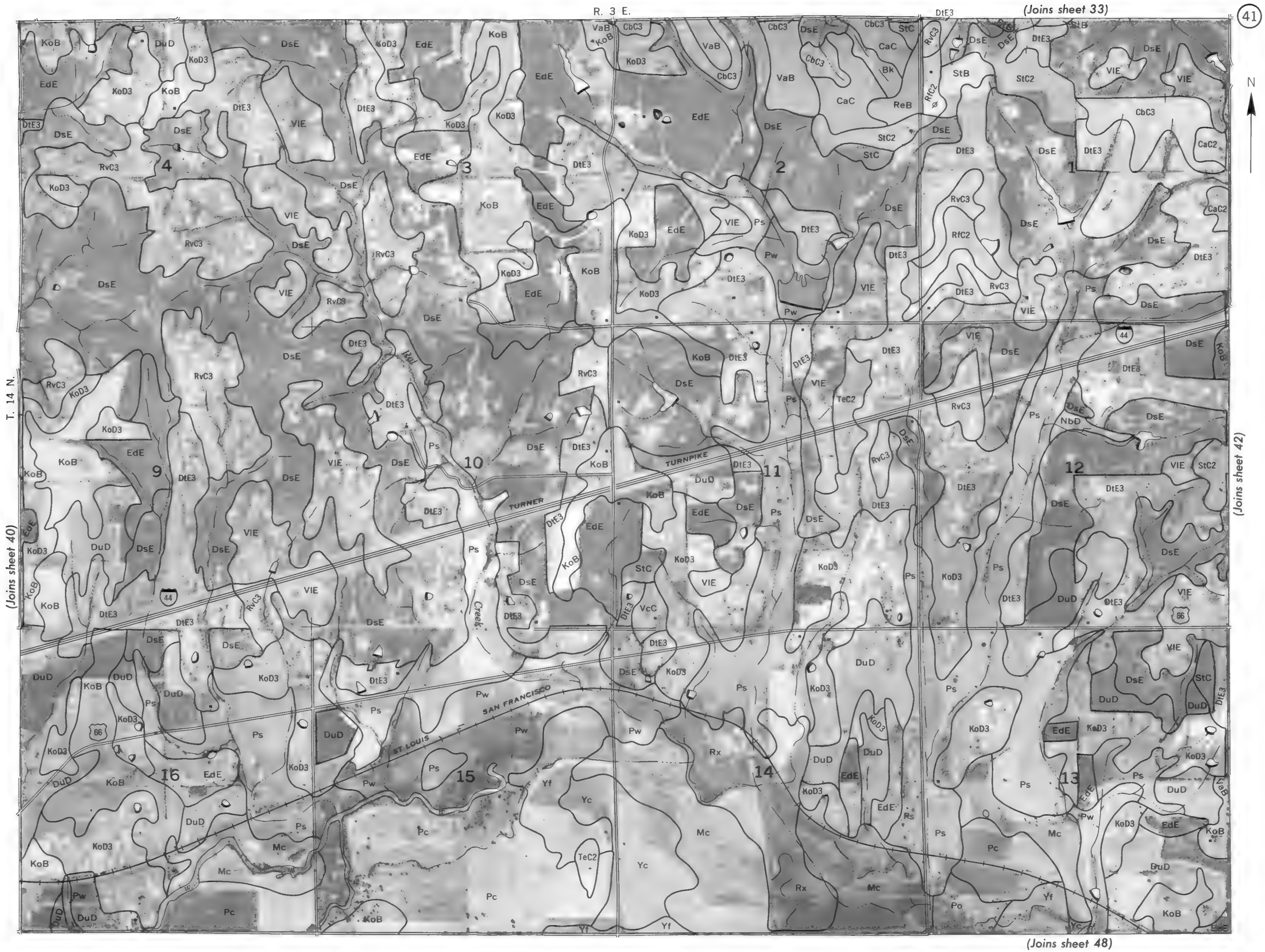
38



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

R. 2 E.
(Joins sheet 31)
39
N
T. 14 N.
(Joins sheet 40)
(Joins sheet 46)
OKLAHOMA COUNTY
BEAR CREEK
DEEP FORK NORTH CANADIAN RIVER
ST LOUIS SAN FRANCISCO
WELLSTON CEMETERY
CAPTAIN CREEK
66
3
4
5
6
7
8
9
10
15
16
17
18
0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

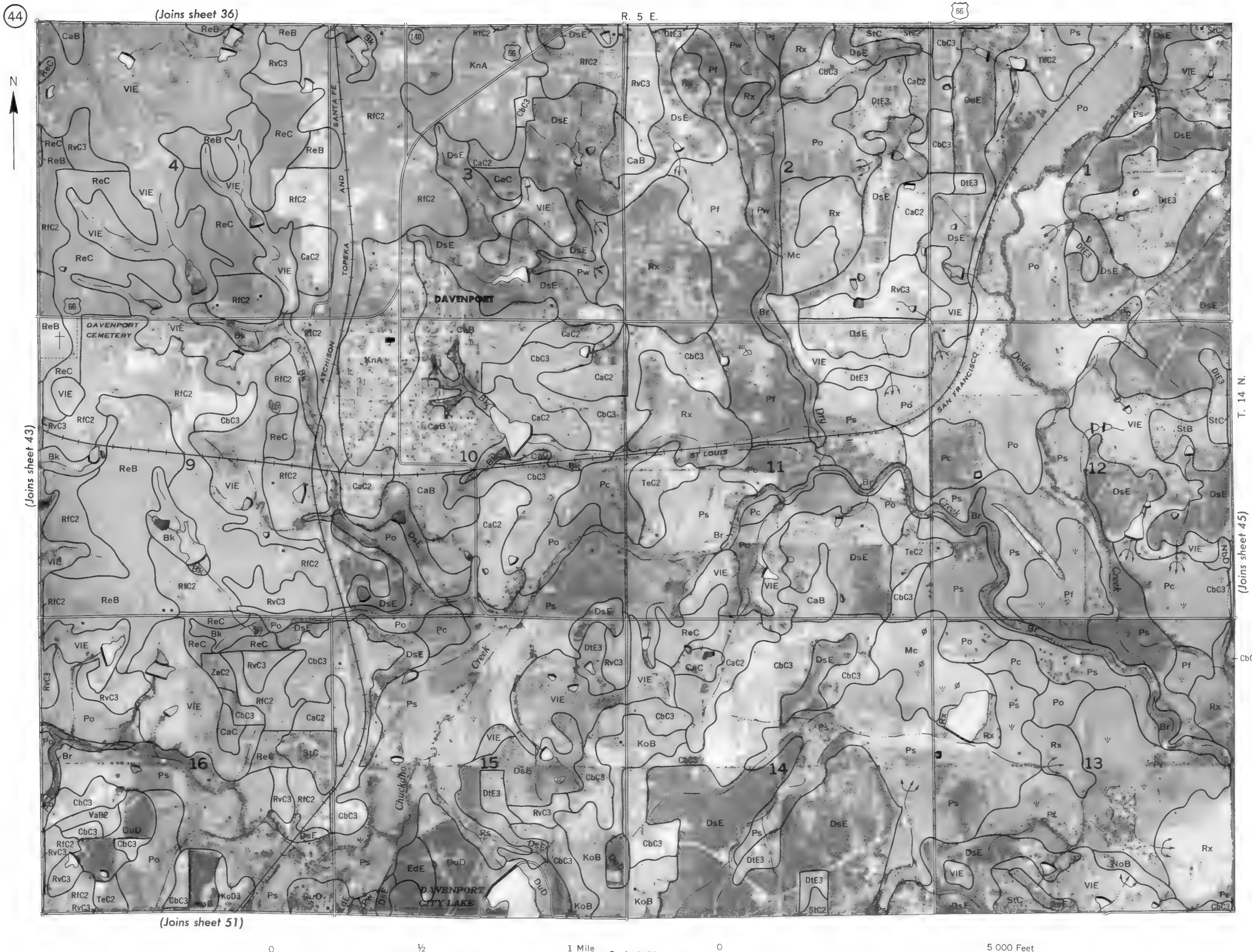
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet



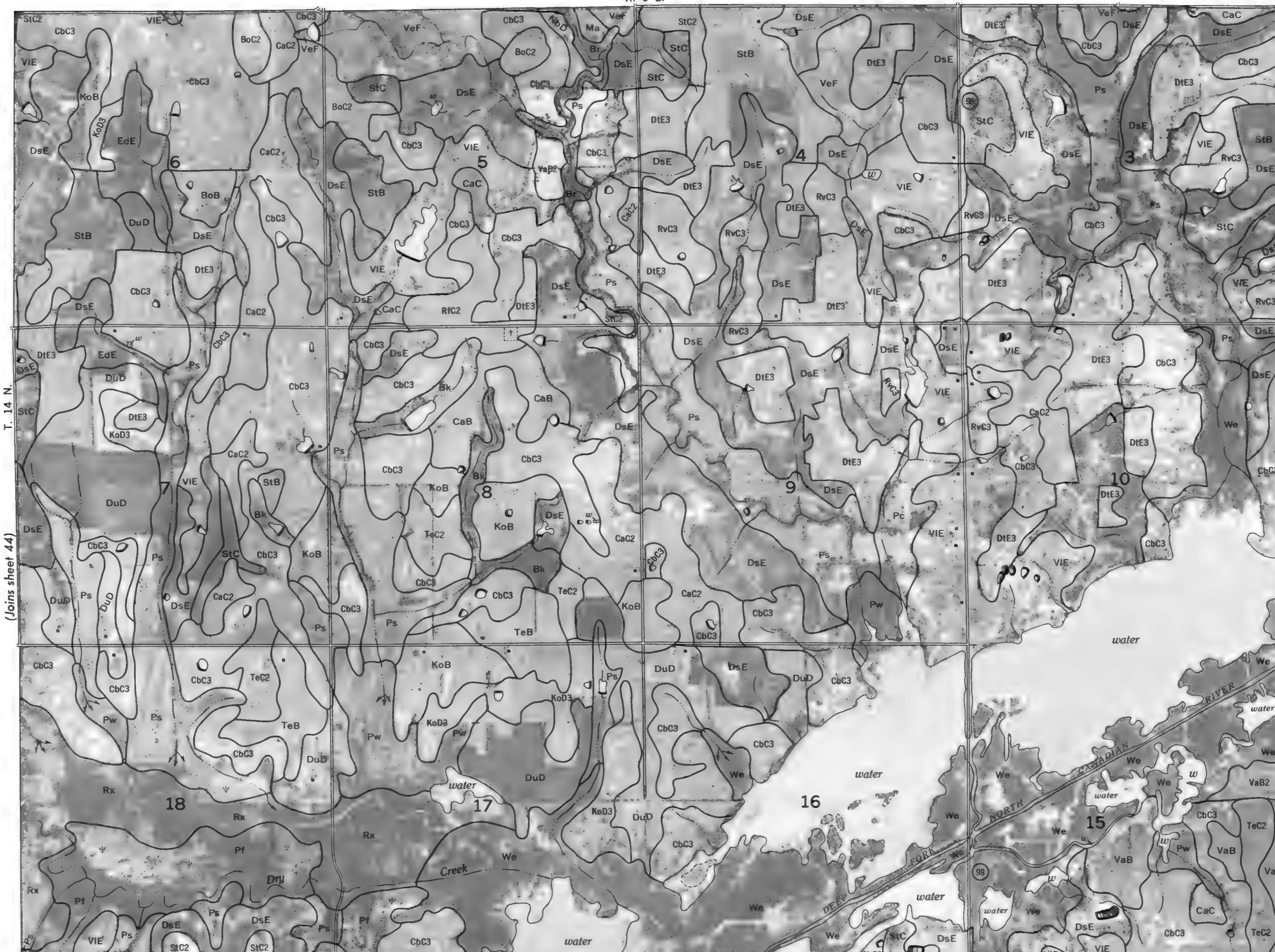
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

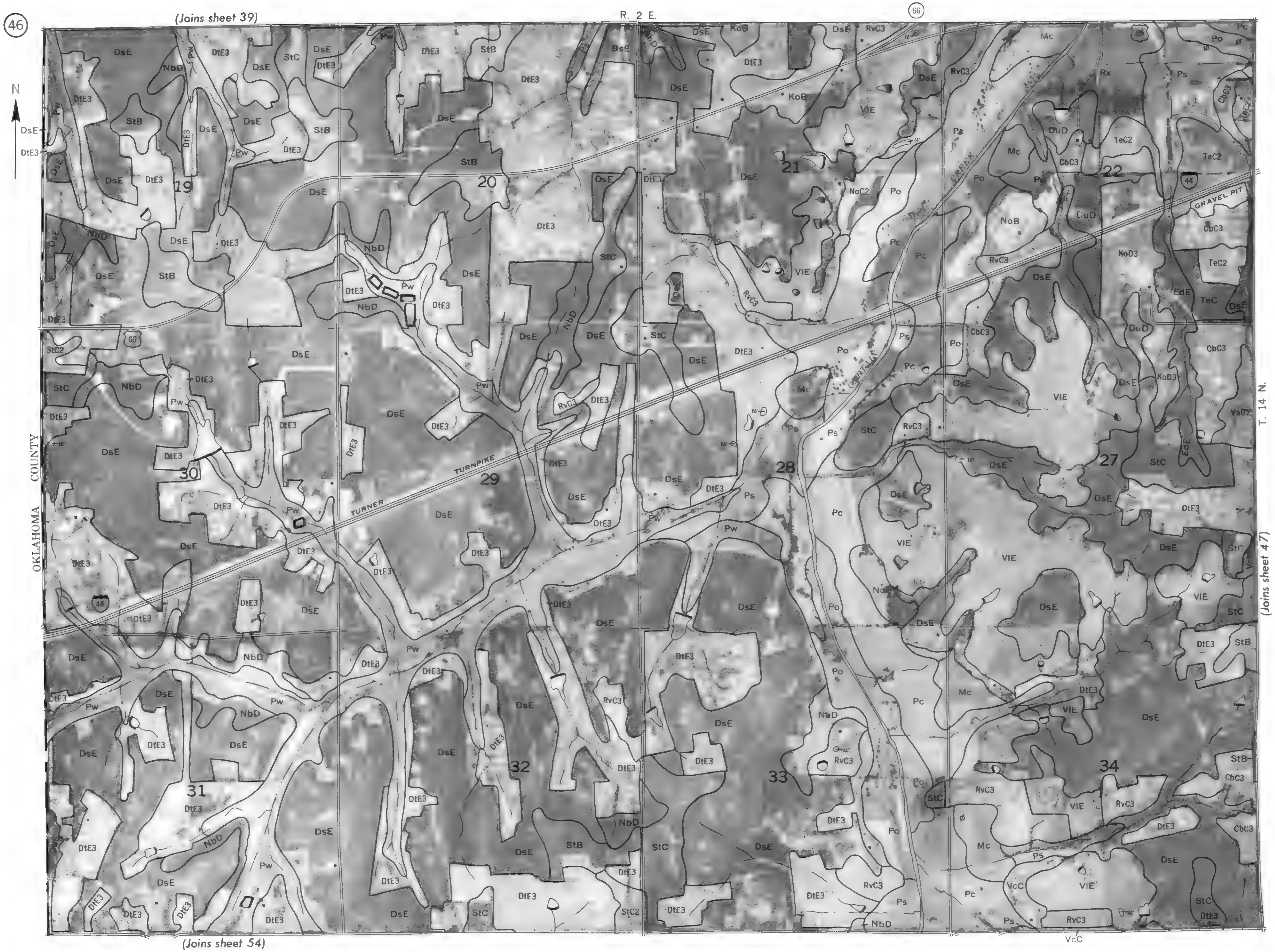
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet


44
(Joins sheet 36)
R. 5 E.
(Joins sheet 43)
(Joins sheet 45)
(Joins sheet 51)
T. 14 N.
DAVENPORT
DAVENPORT CEMETERY
DAVENPORT CITY LAKE
ATCHISON TOPEKA AND SANTA FE
ST LOUIS SAN FRANCISCO
Dry Creek
Dosie Creek
Chuckaho Creek
0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

(45)



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

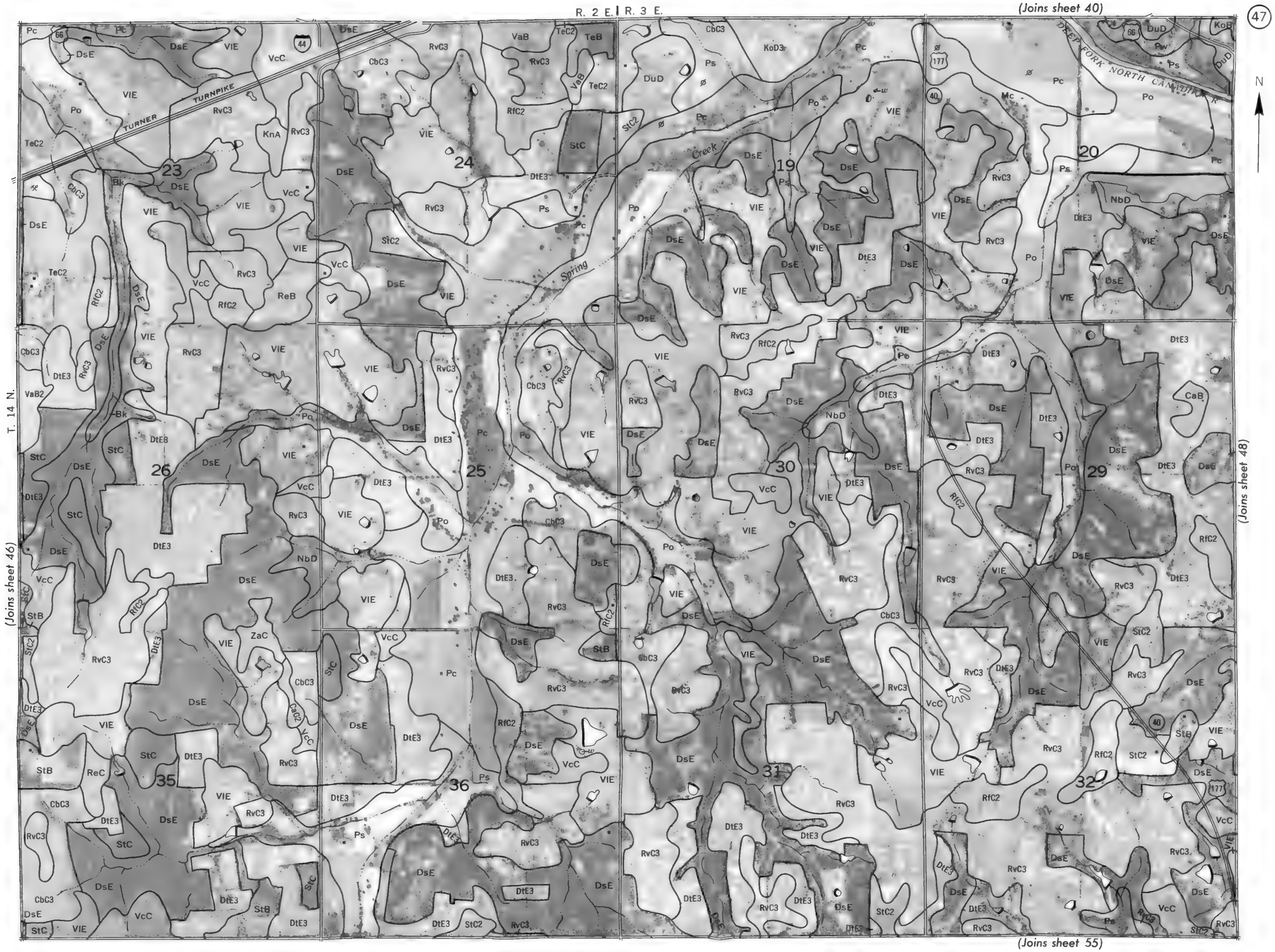


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 46

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

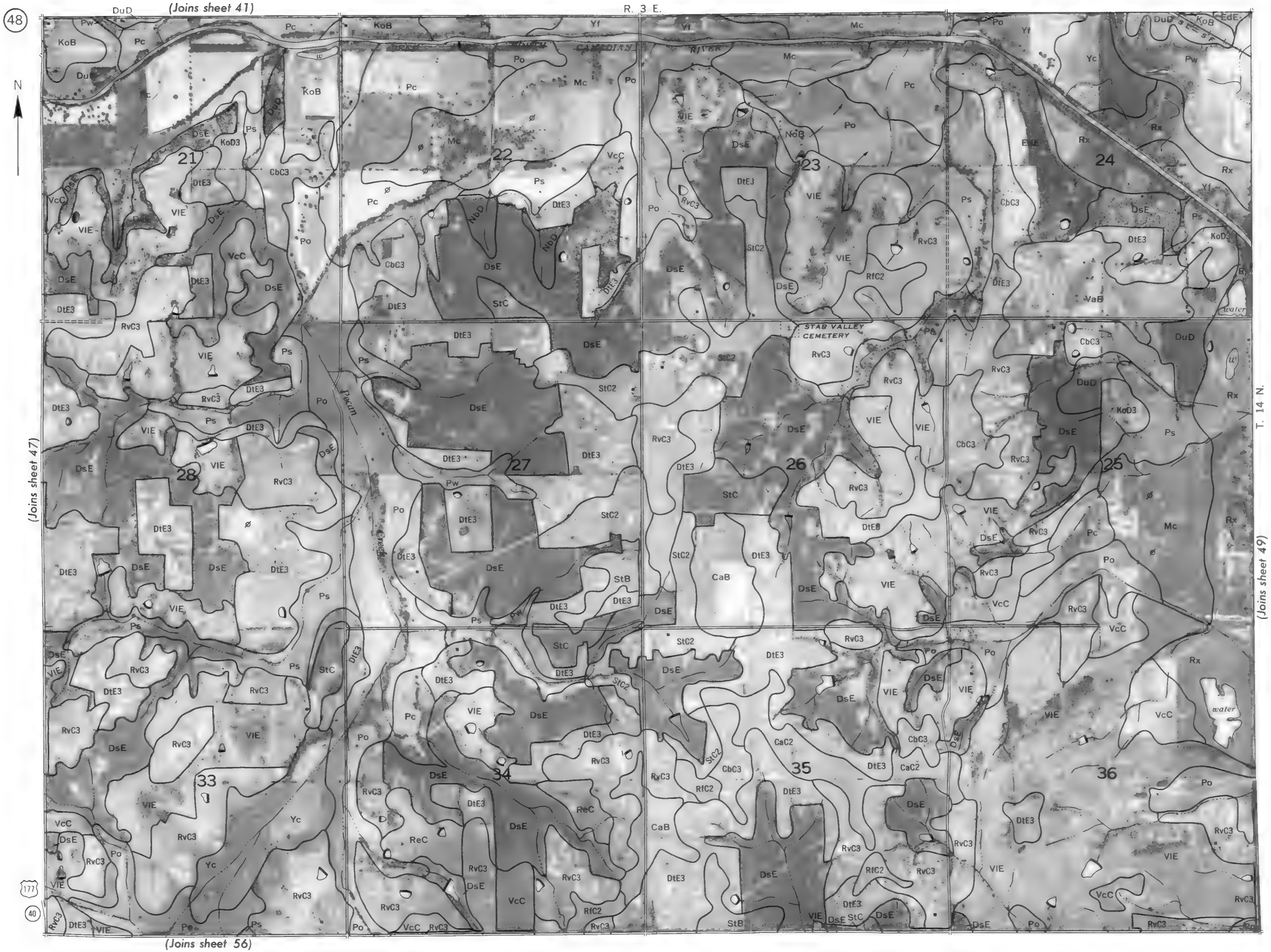


0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

LINCOLN COUNTY, OKLAHOMA NO. 47

LINCOLN COUNTY, OKLAHOMA — SHEET NUMBER 48



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 48

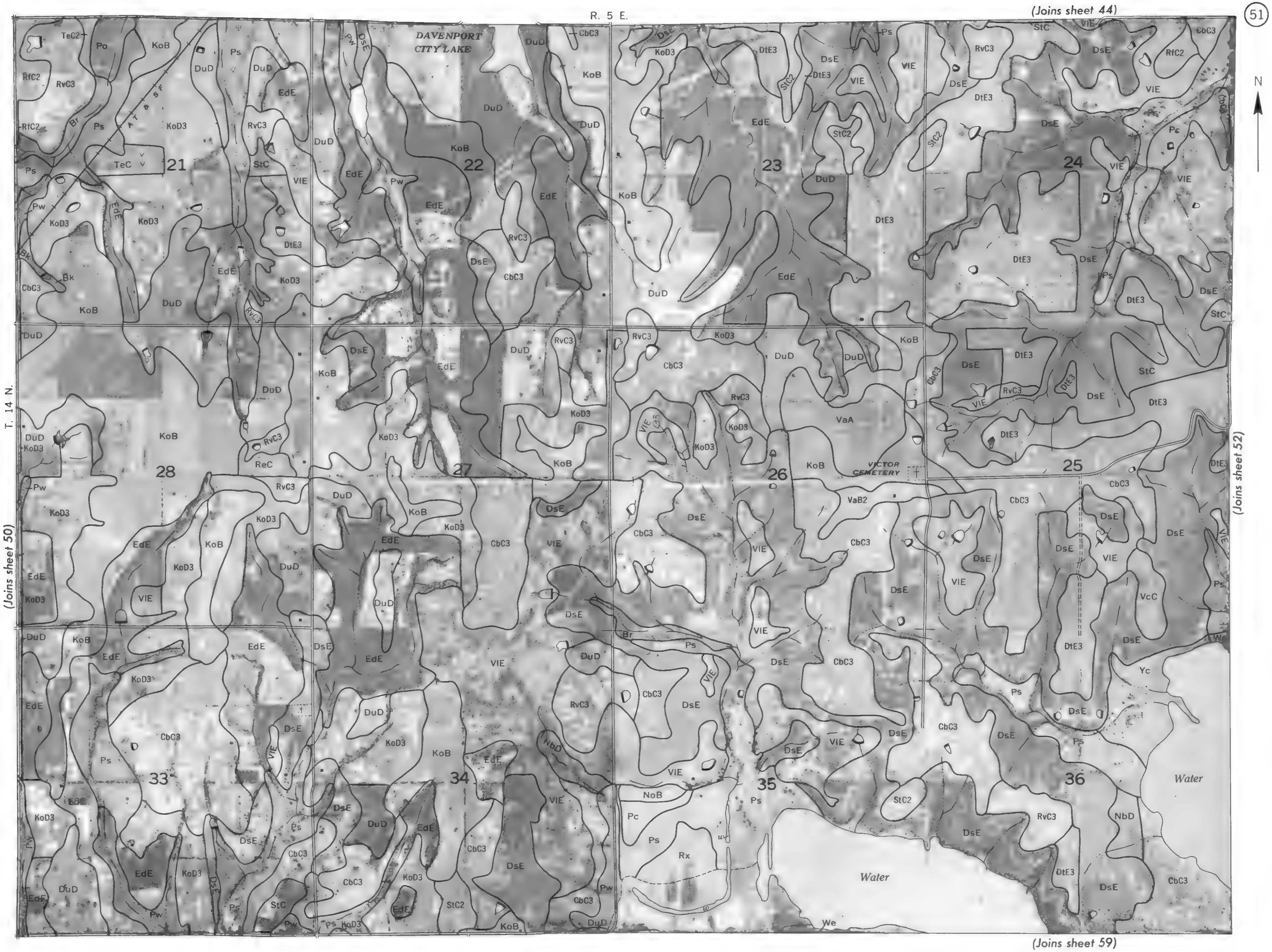
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 49

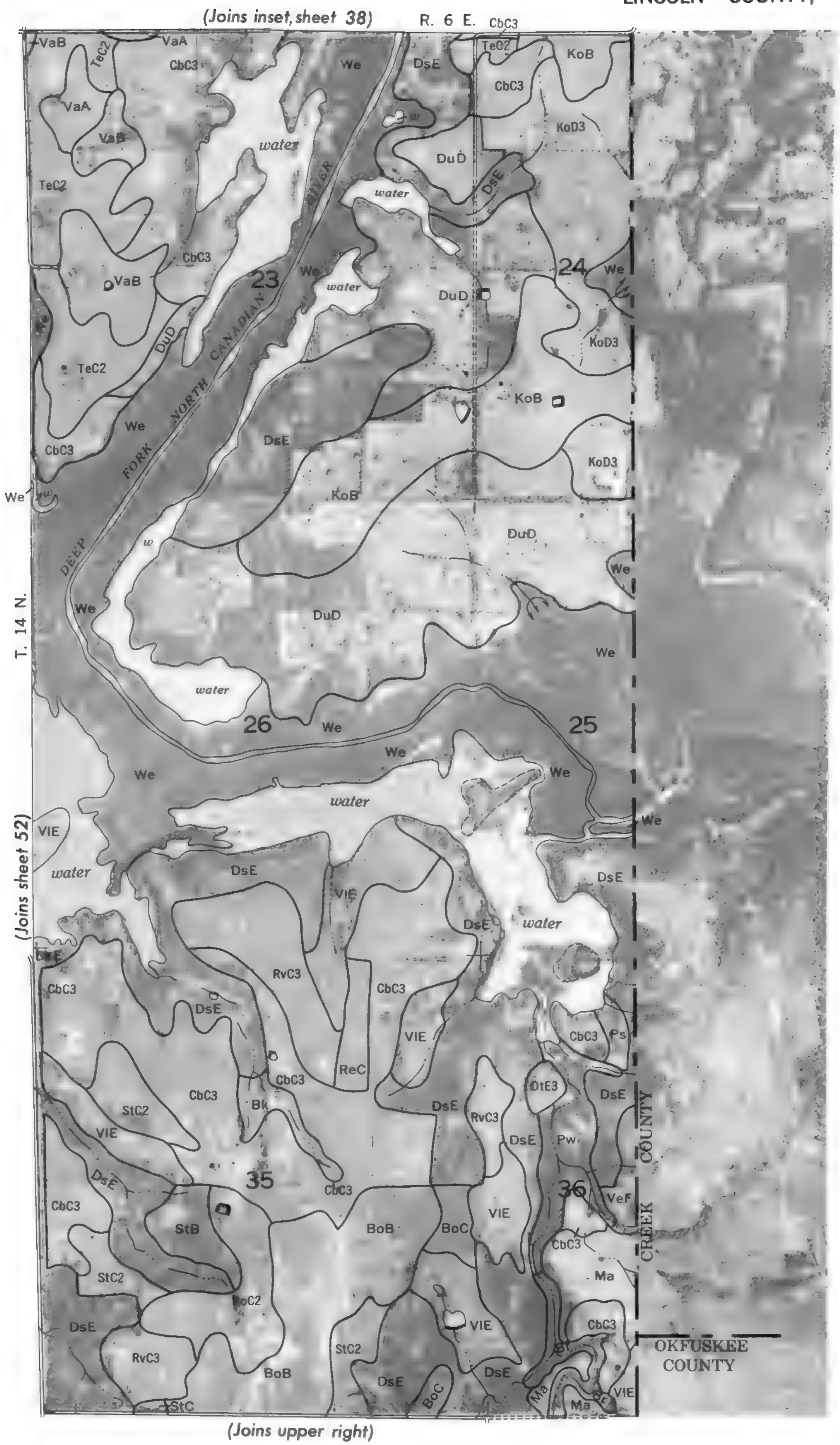

50
(Joins sheet 43)
R. 4 E. | R. 5 E.
N
(Joins sheet 49)
(Joins sheet 51)
(Joins sheet 58)
T. 14 N.
MORNING STAR CEMETERY
DEEP FORK NORTH CANADIAN RIVER
ATCHISON TOPEKA AND SANTA FE
19
20
23
24
25
26
29
30
31
32
35
36
0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

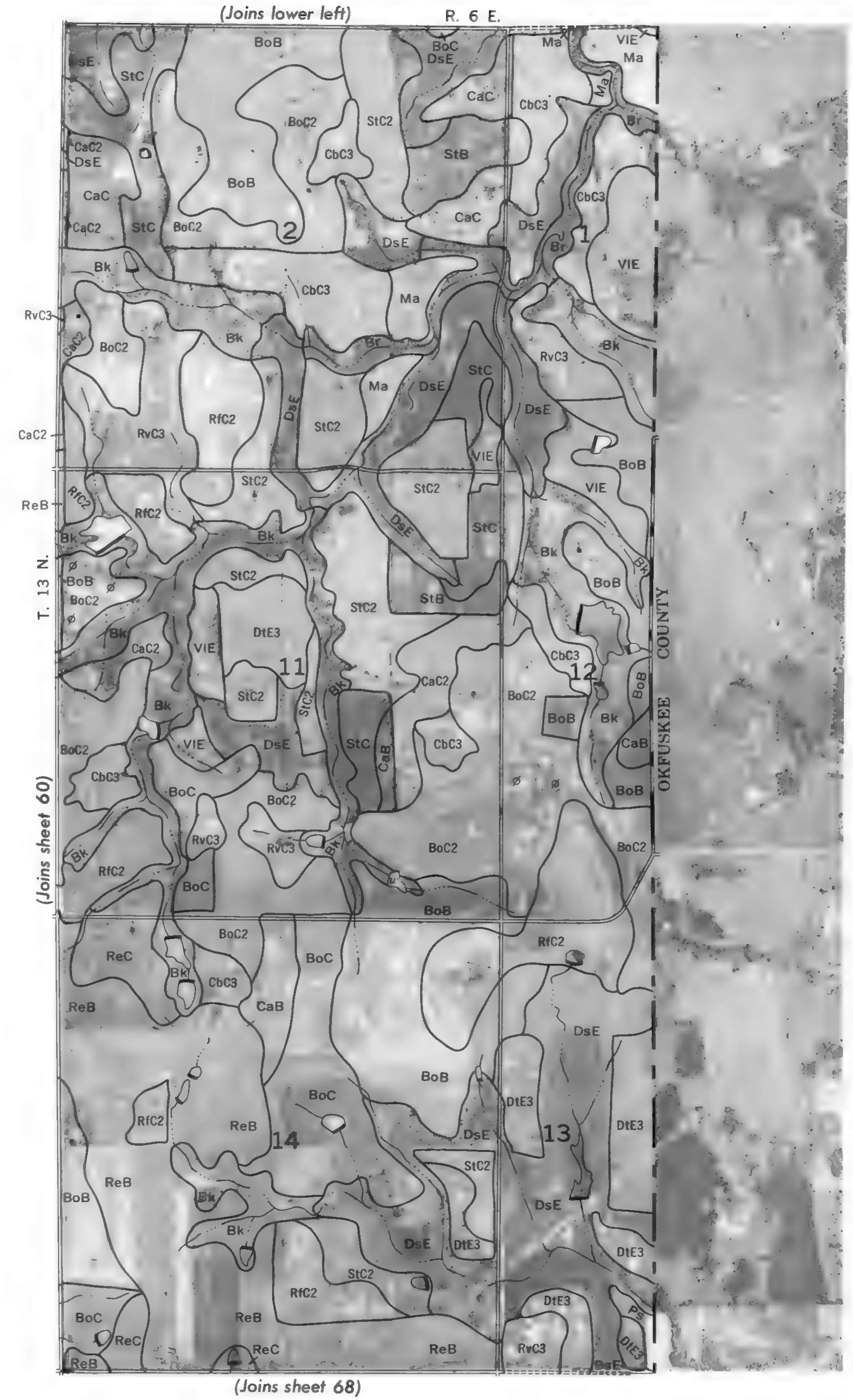


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 52

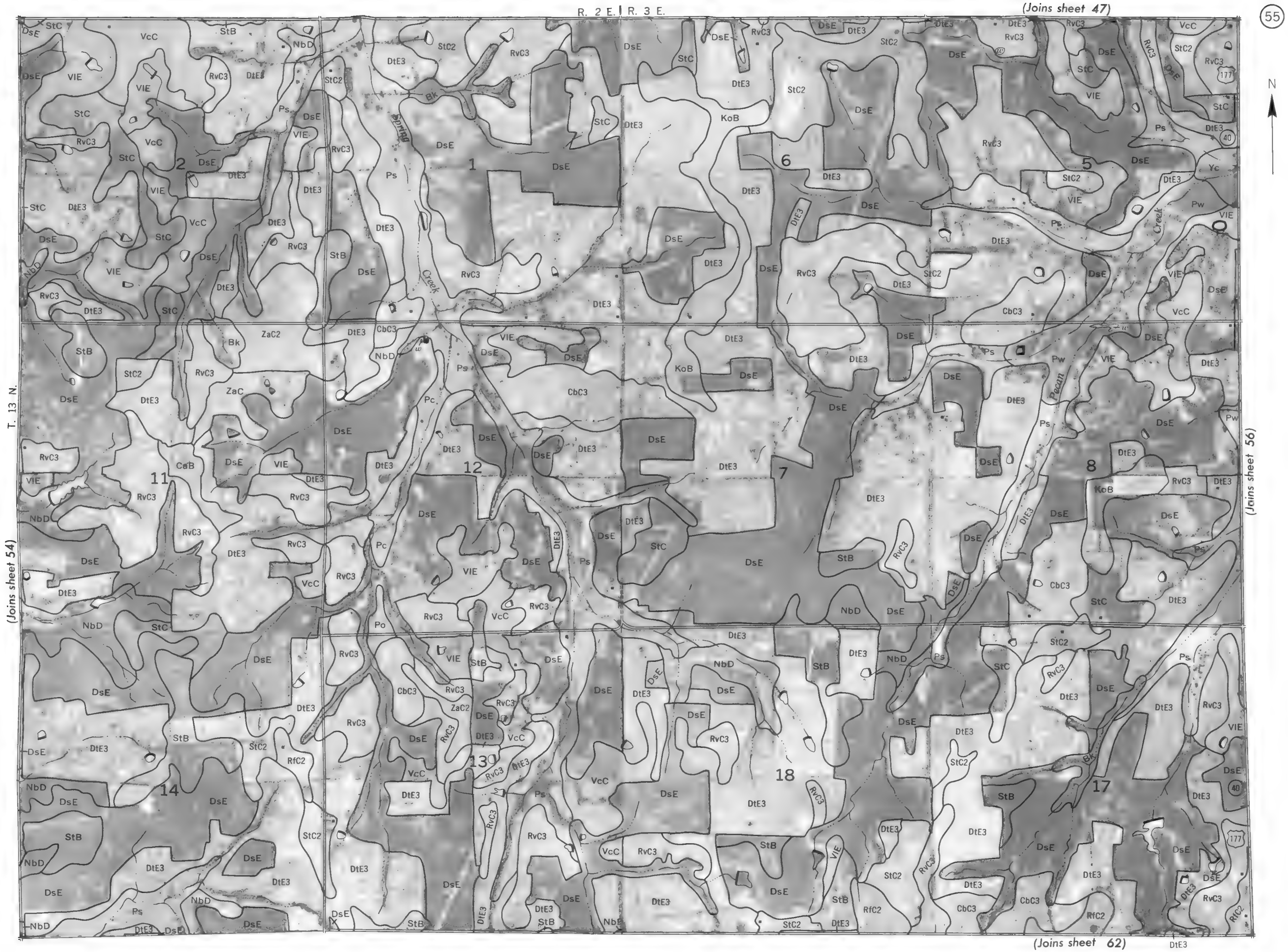
N



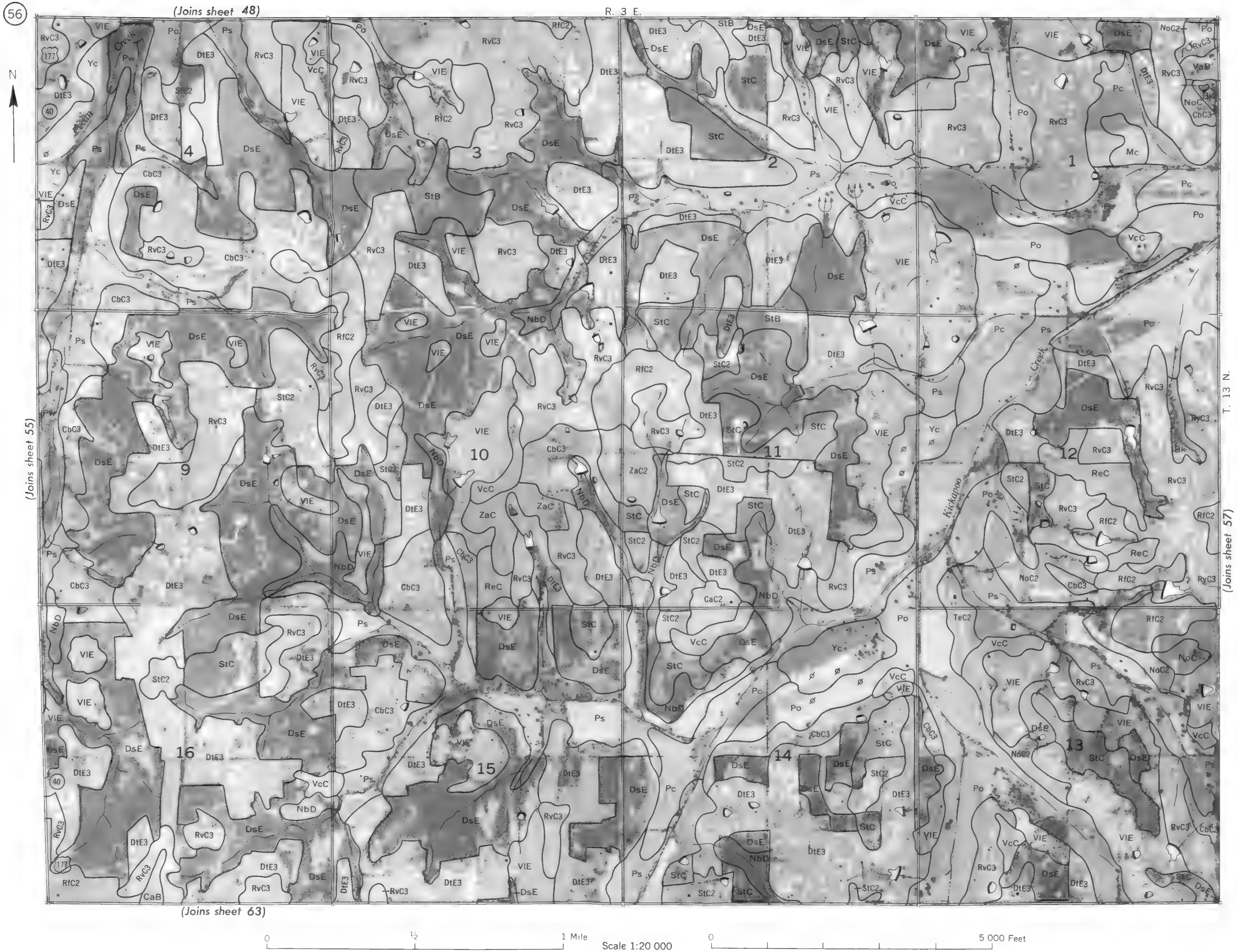


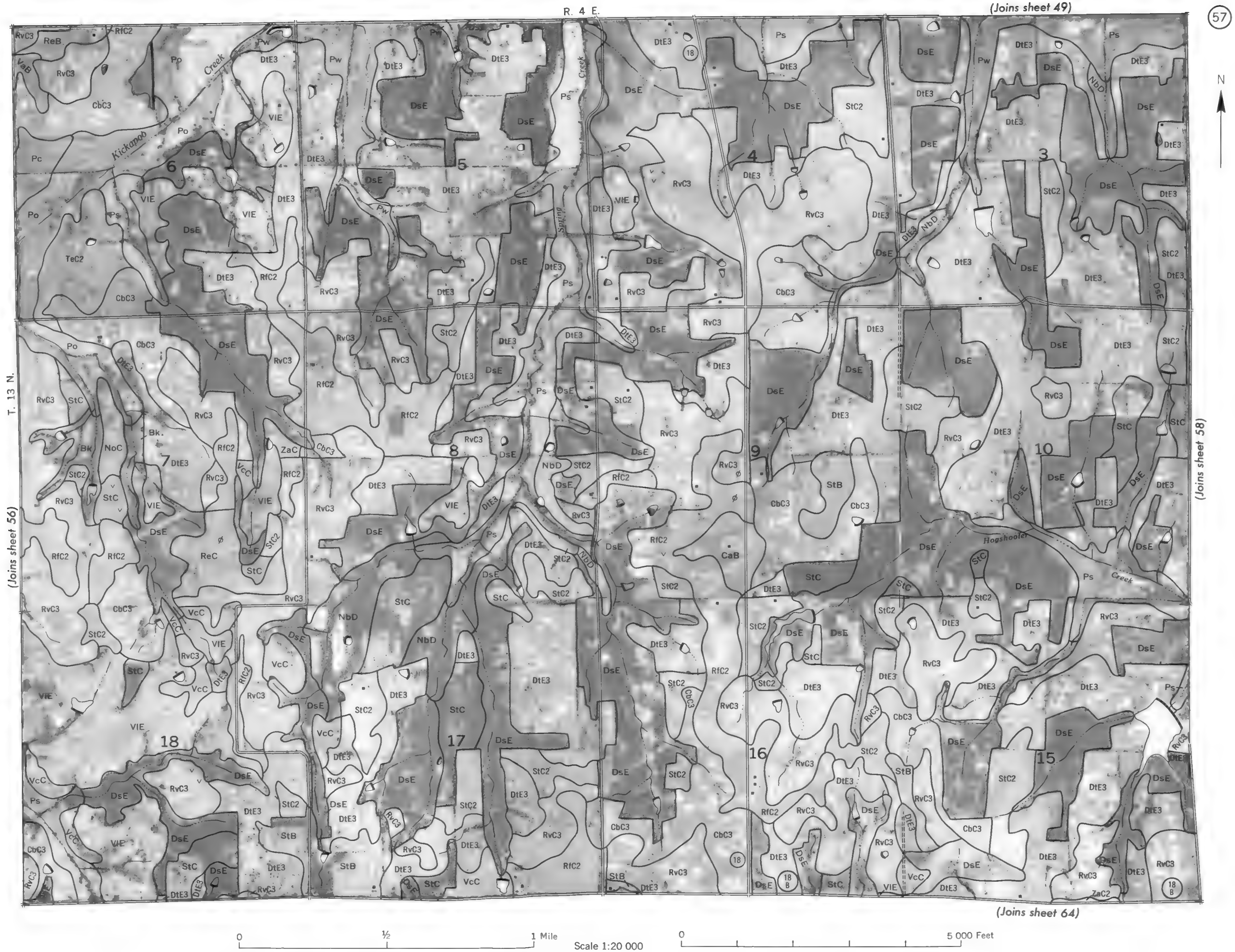
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

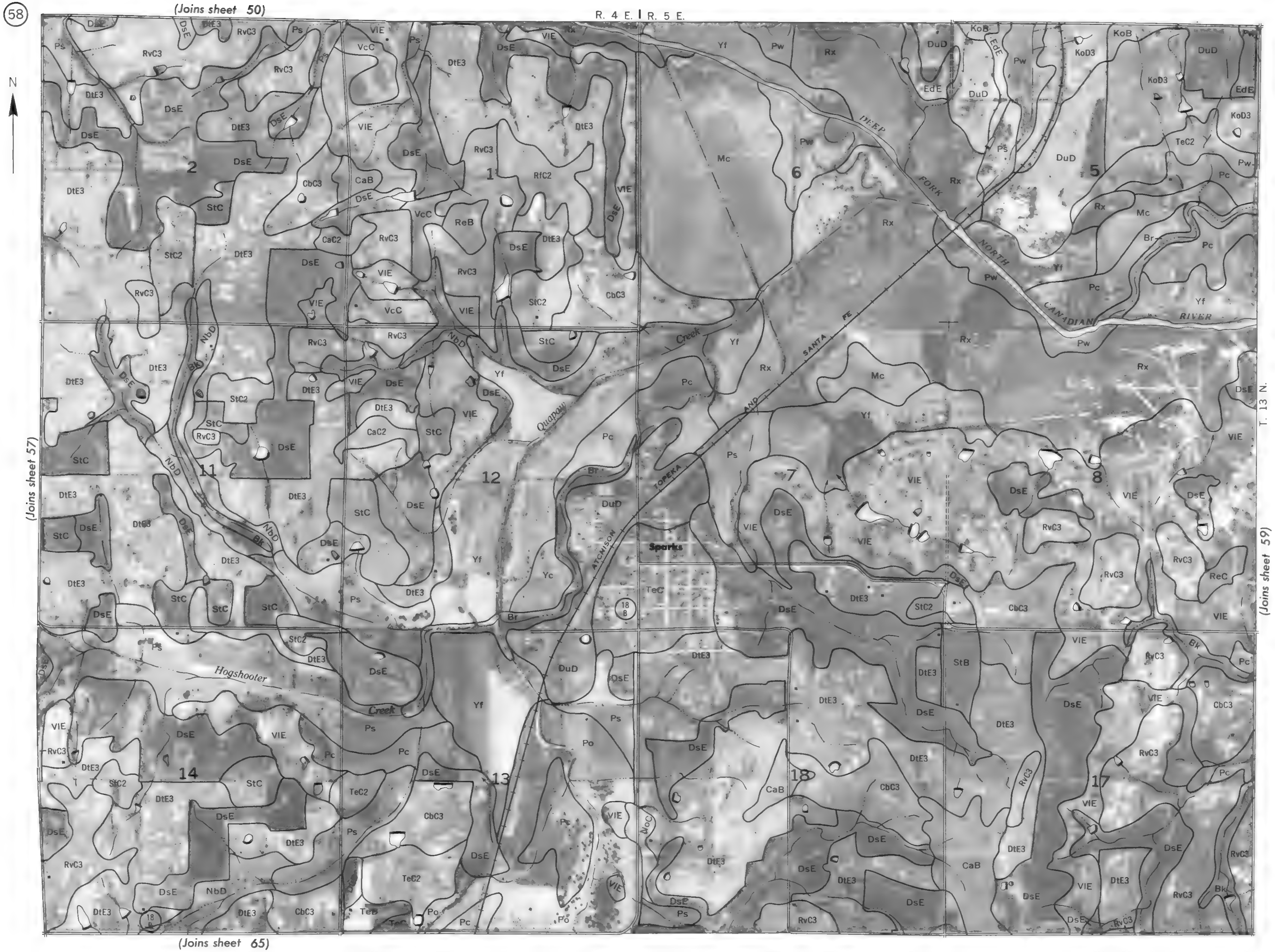
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet


56
(Joins sheet 48)
R. 3 E.
N
T. 13 N.
(Joins sheet 55)
(Joins sheet 57)
(Joins sheet 63)
Kickapoo Creek
0
½
1 Mile
Scale 1:20 000
0
5 000 Feet


(Joins sheet 49)
R. 4 E.
57
N
T. 13 N.
(Joins sheet 56)
(Joins sheet 58)
(Joins sheet 64)
Kickapoo Creek
Spring Creek
Hogshooter Creek
0
½
1 Mile
Scale 1:20 000
0
5 000 Feet

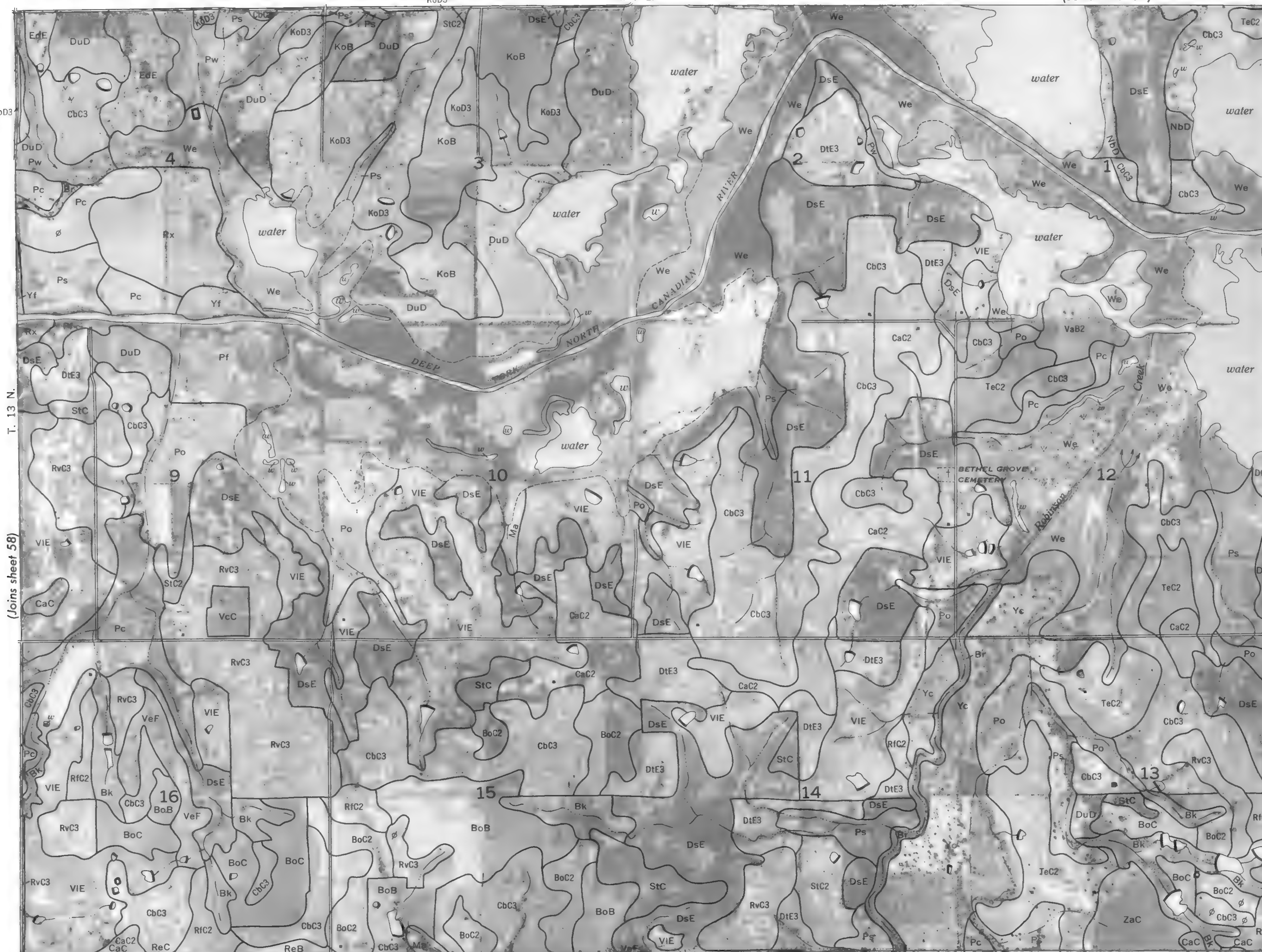


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 58

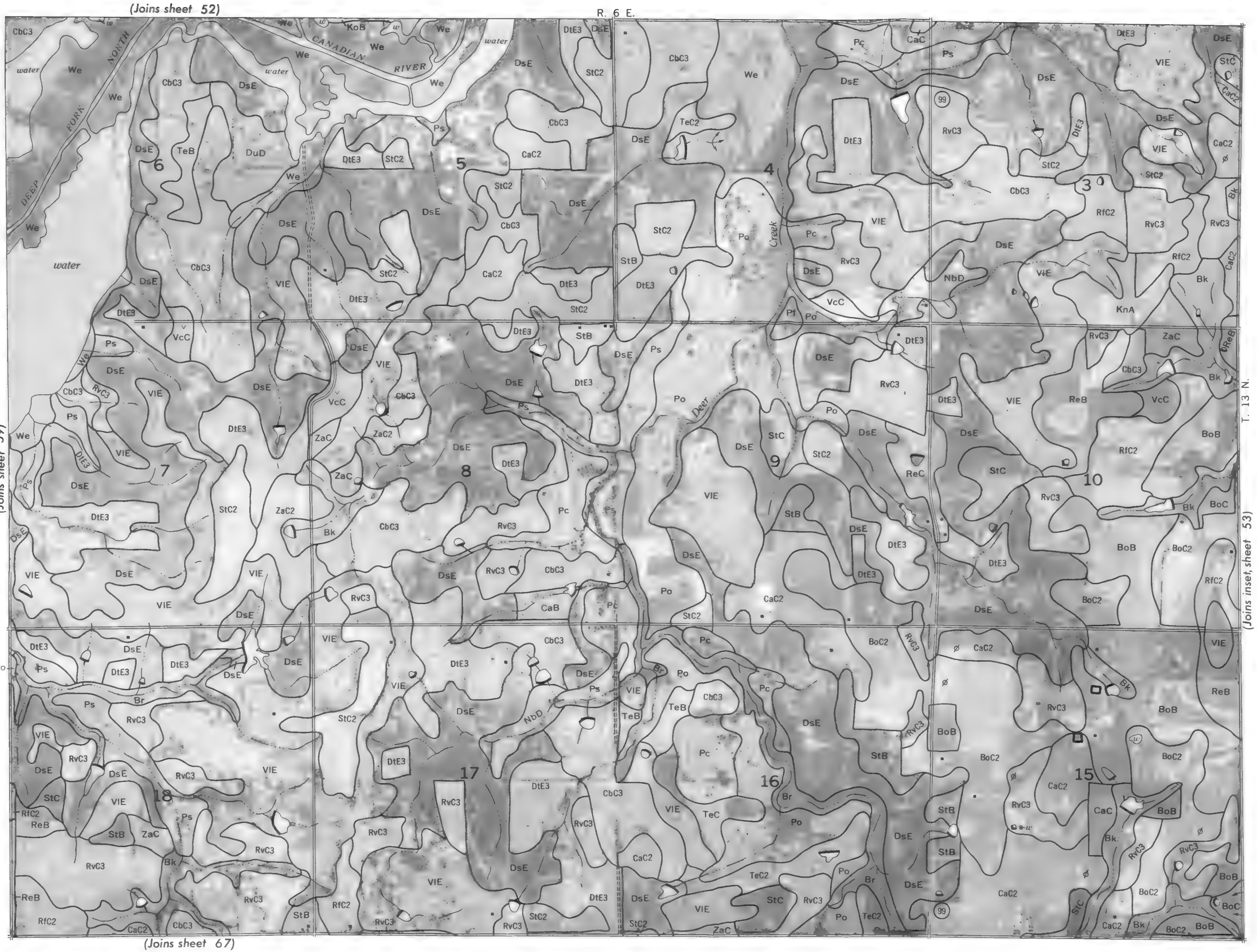
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.

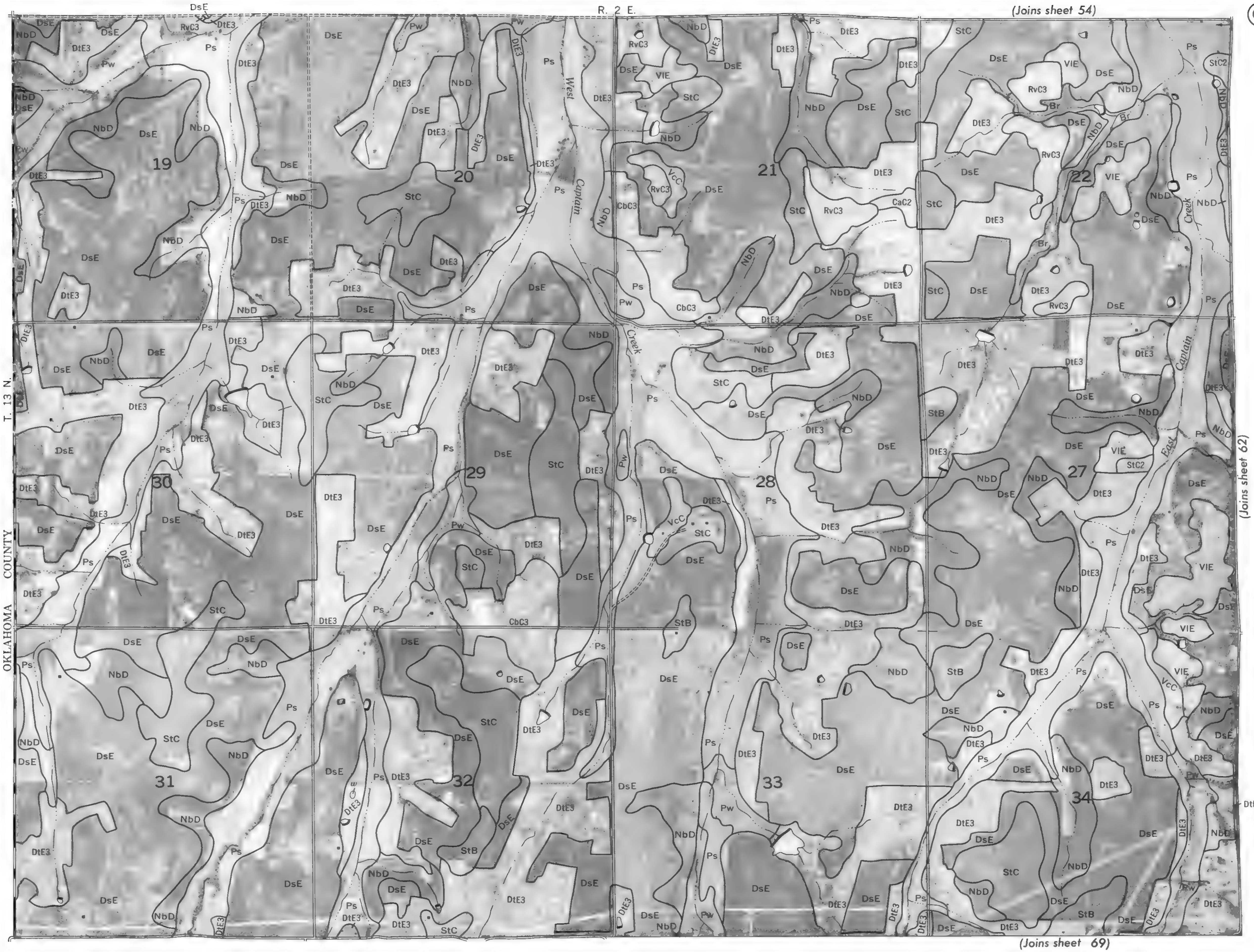


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

60



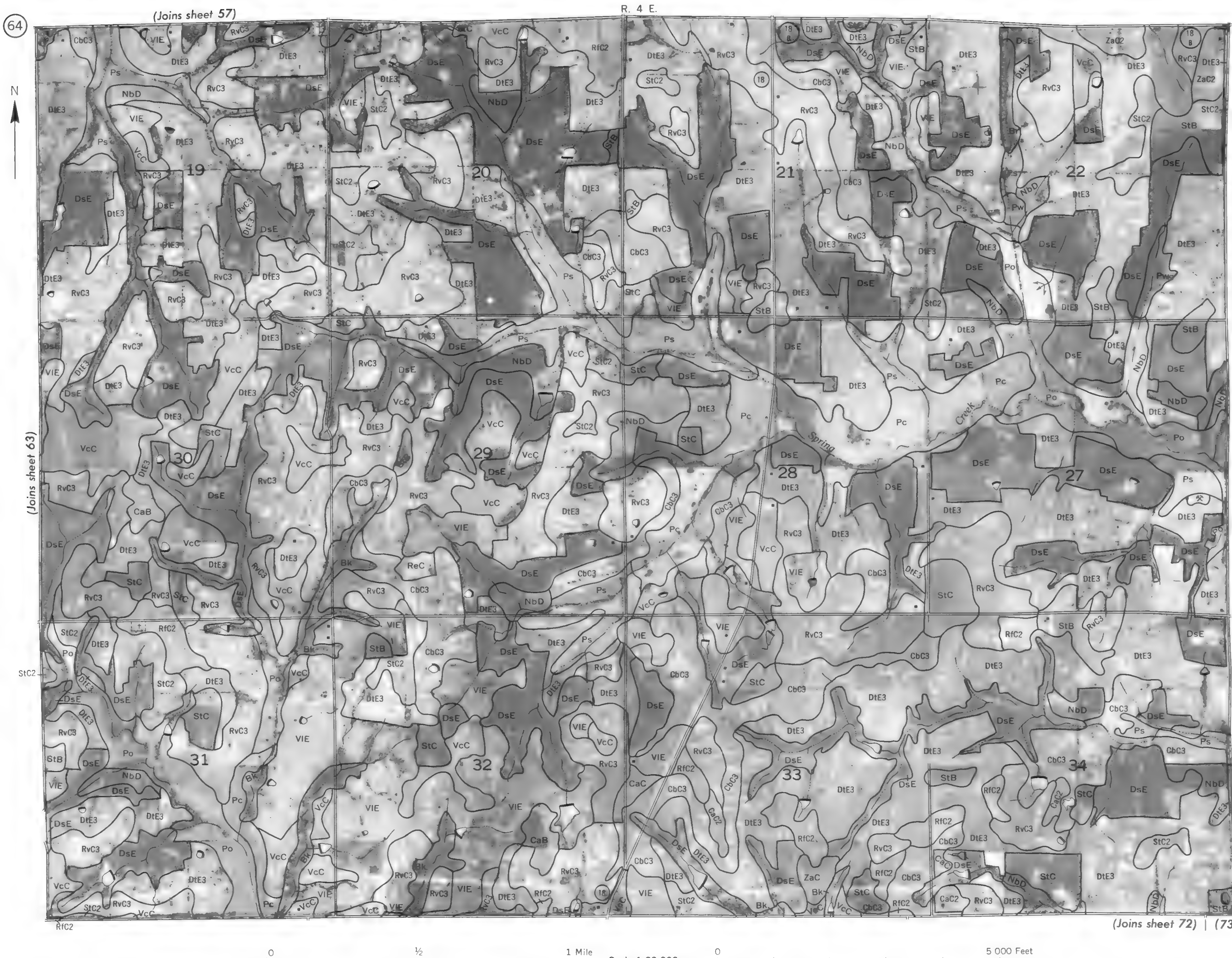
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet



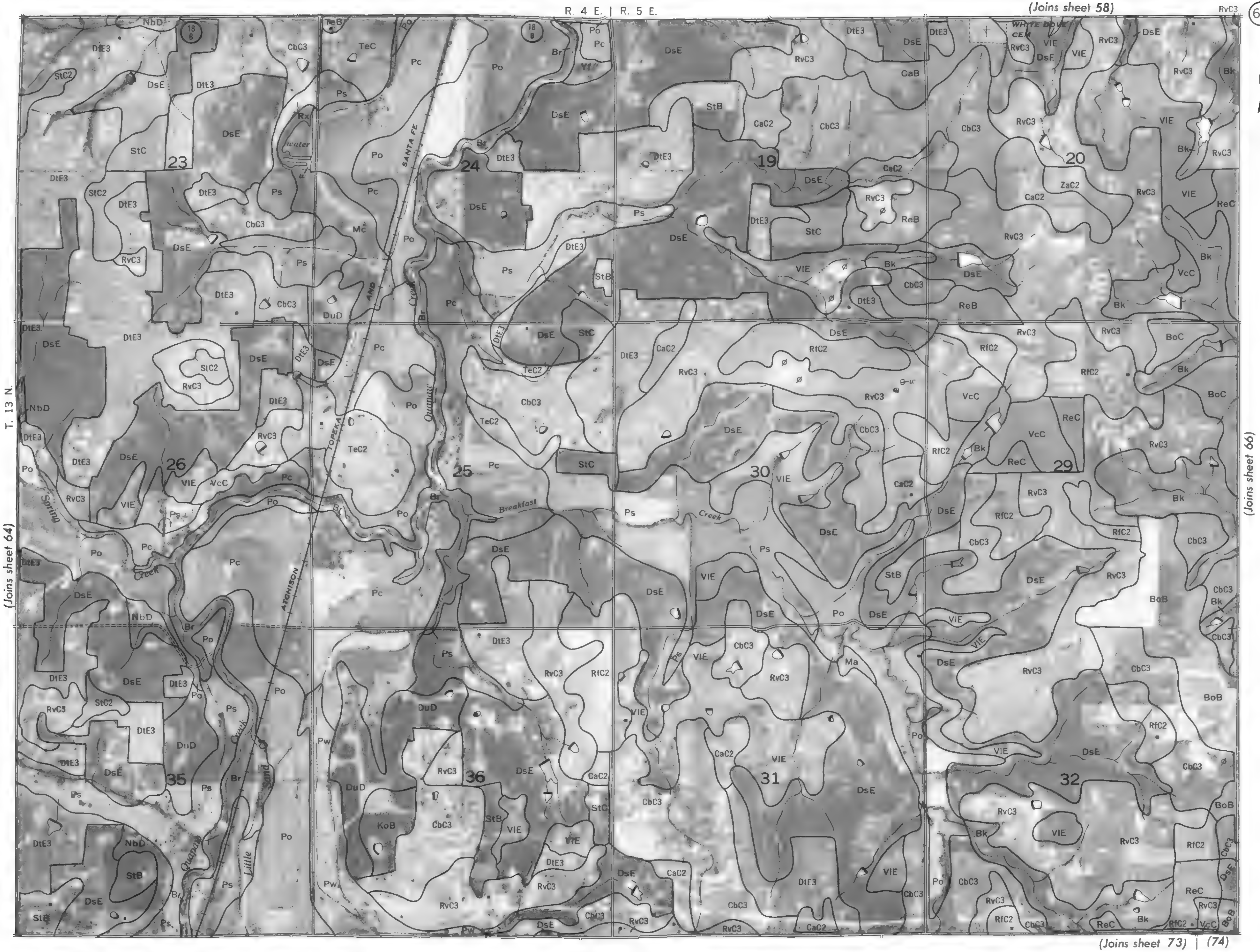
0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 62

0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet



64
(Joins sheet 57)
R. 4 E.
N
19
20
21
22
30
29
28
27
31
32
33
34
Spring Creek
T. 13 N.
(Joins sheet 63)
(Joins sheet 65)
(Joins sheet 72) | (73)
0
½
1 Mile
Scale 1:20 000
0
5 000 Feet

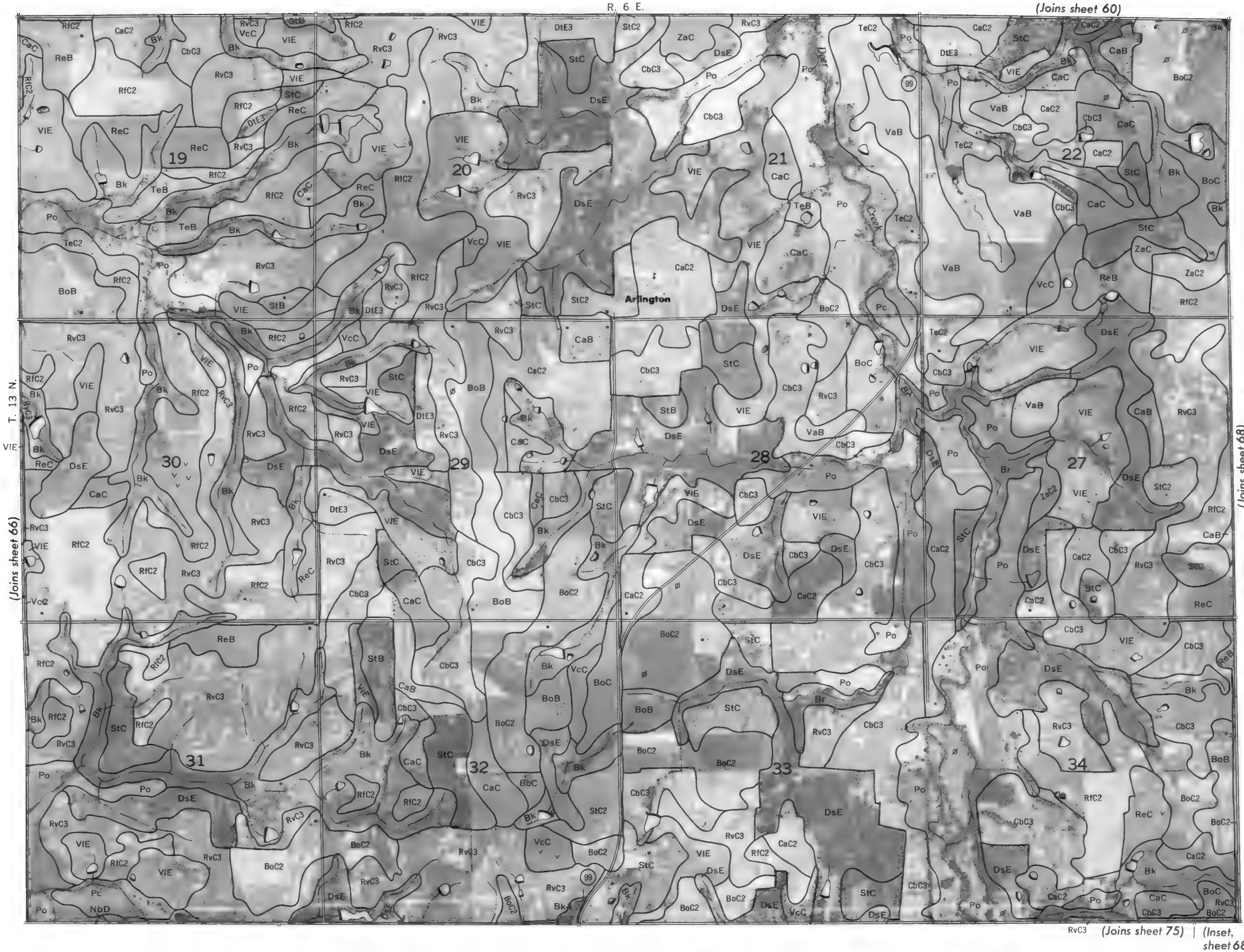


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

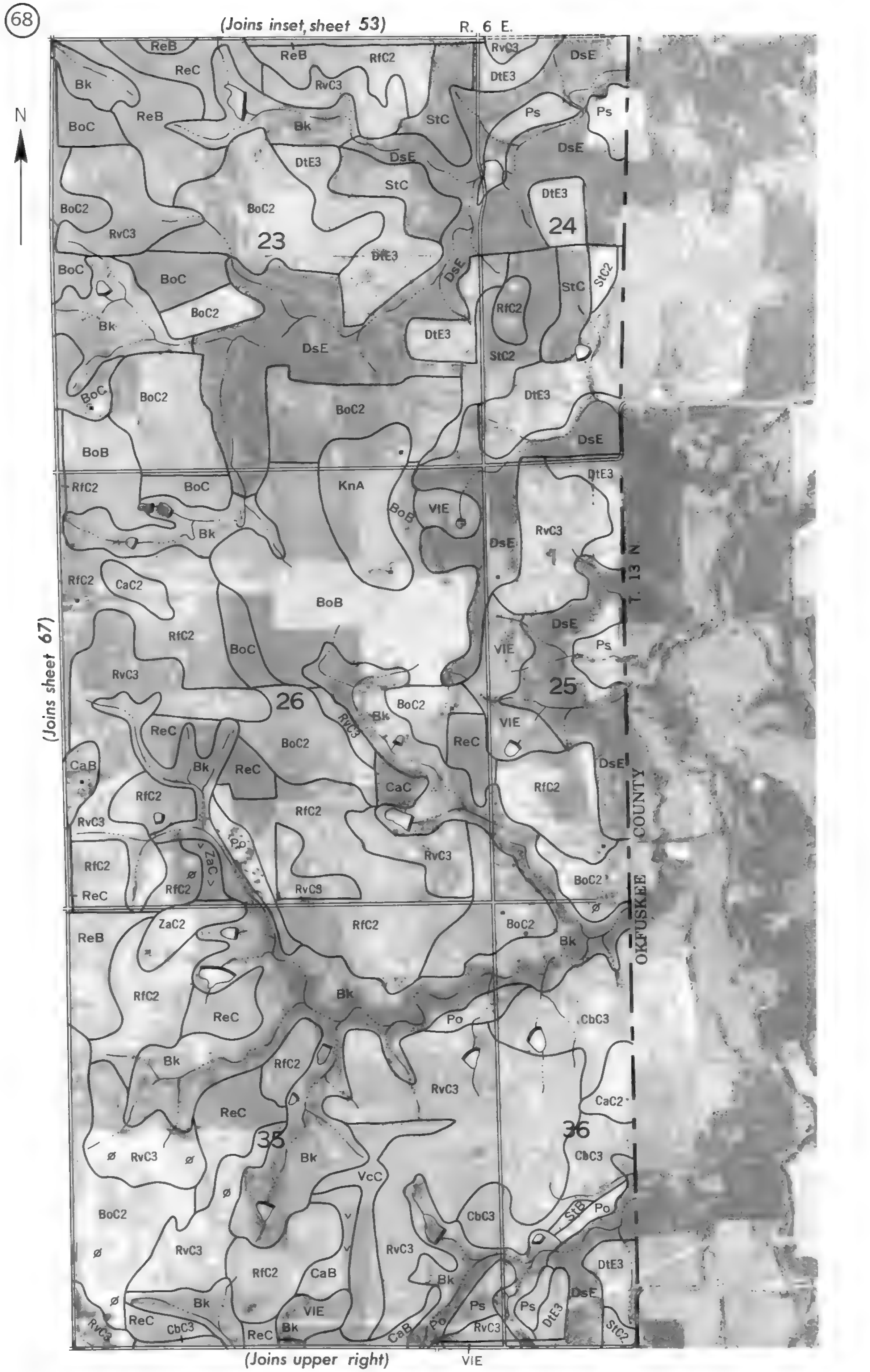
66

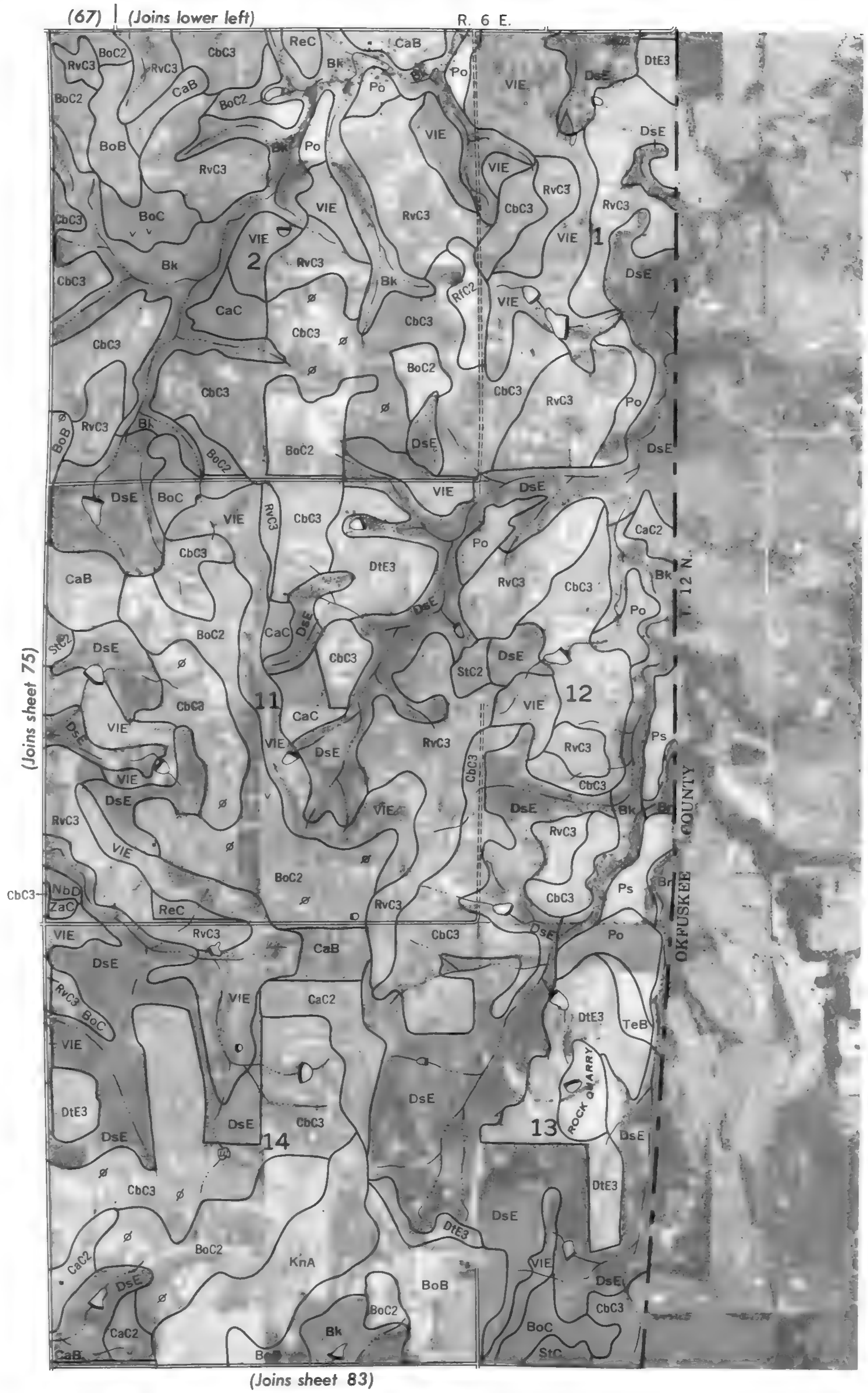
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 66



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet





0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 68

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.


R. 2 E.
(Joins sheet 61)
69
N
T. 12 N.
OKLAHOMA COUNTY
(Joins sheet 70)
(Joins sheet 76)
FERRELL CEMETERY
Captain
West
Quapaw
6
5
4
3
7
8
9
10
18
17
16
15
0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

(70)

(Joins sheet 62)

R. 2 E. | R. 3 E.

N

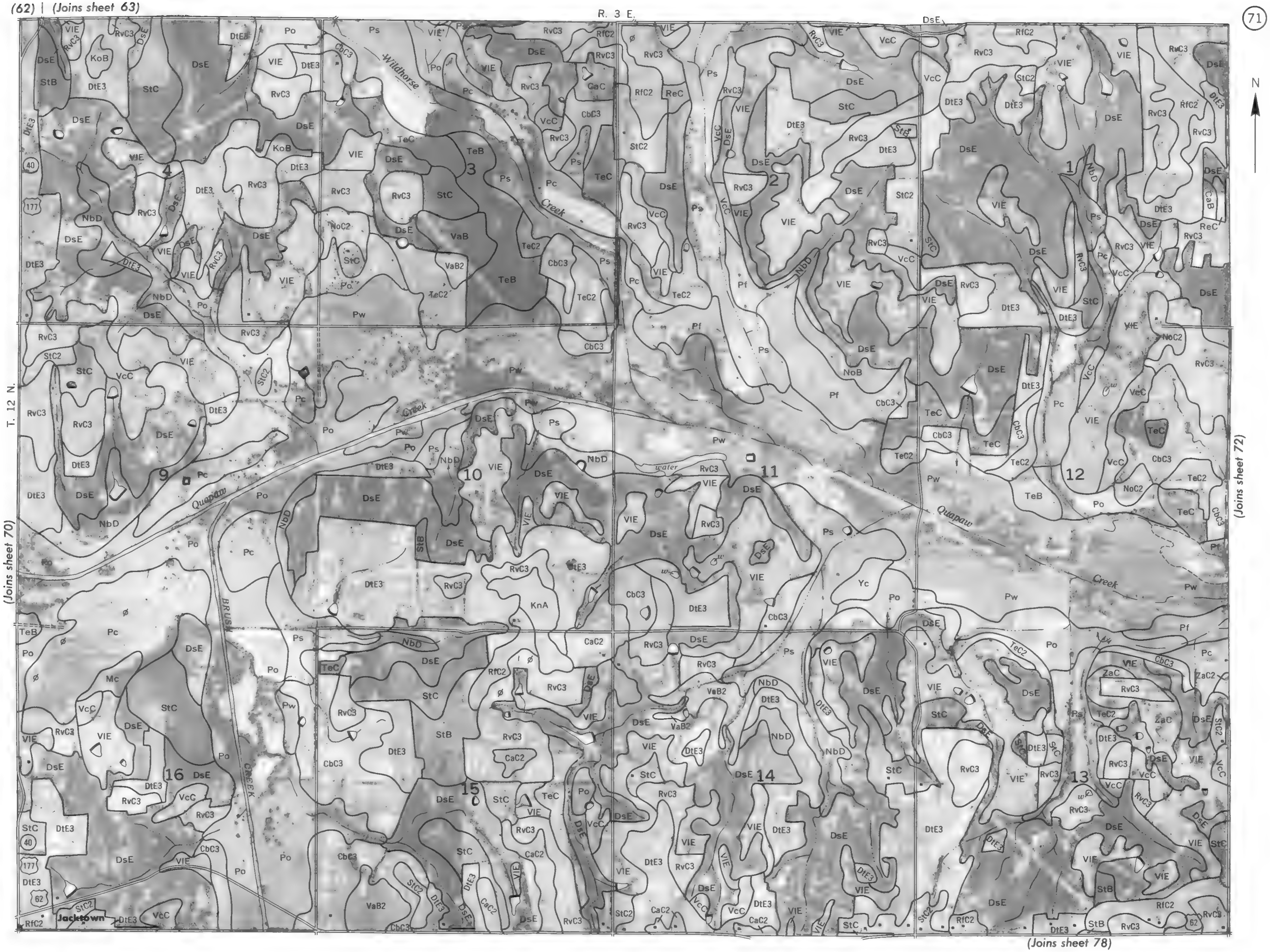
(Joins sheet 69)

T. 12 N.

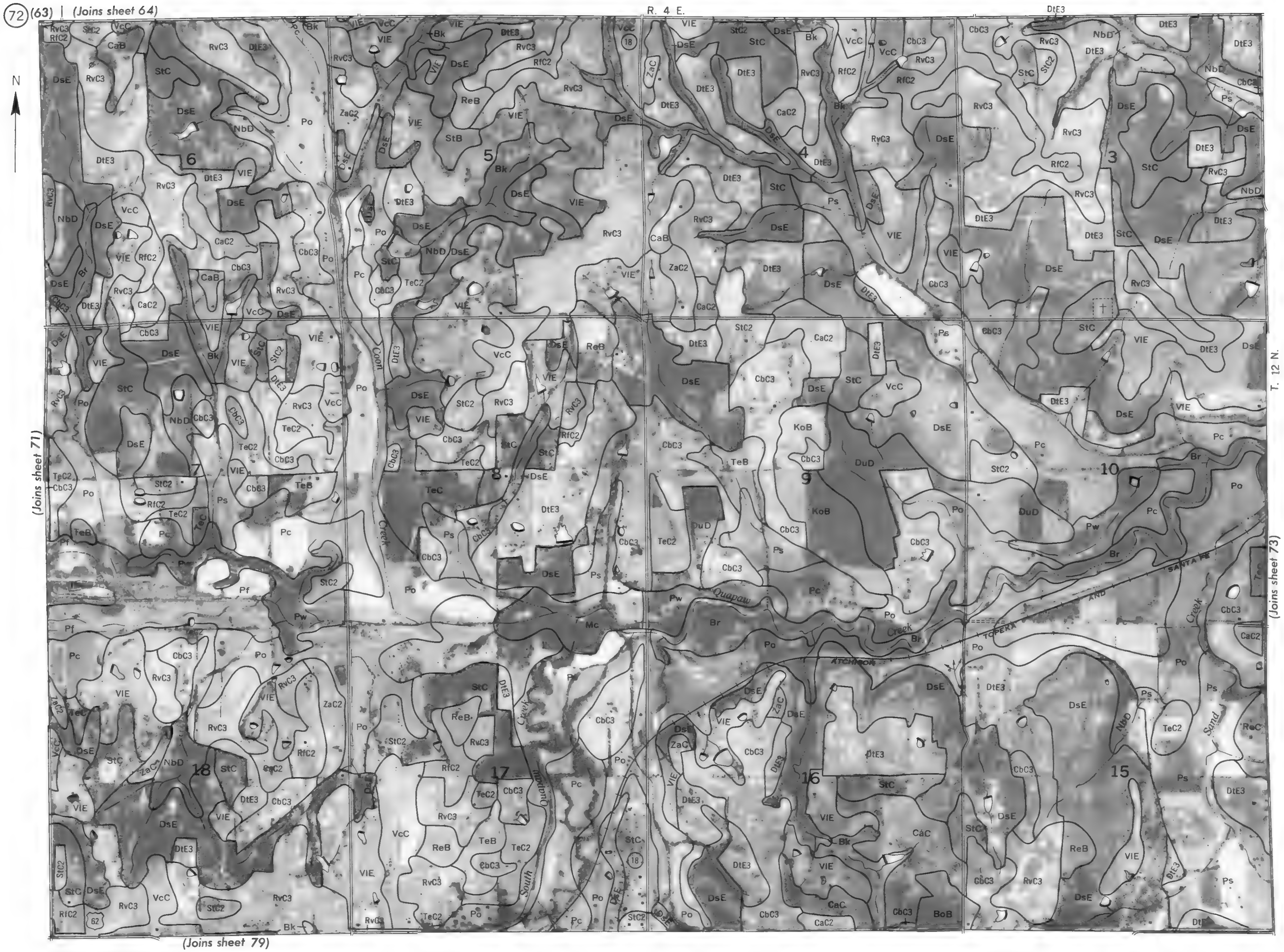
(Joins sheet 71)

(Joins sheet 77)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

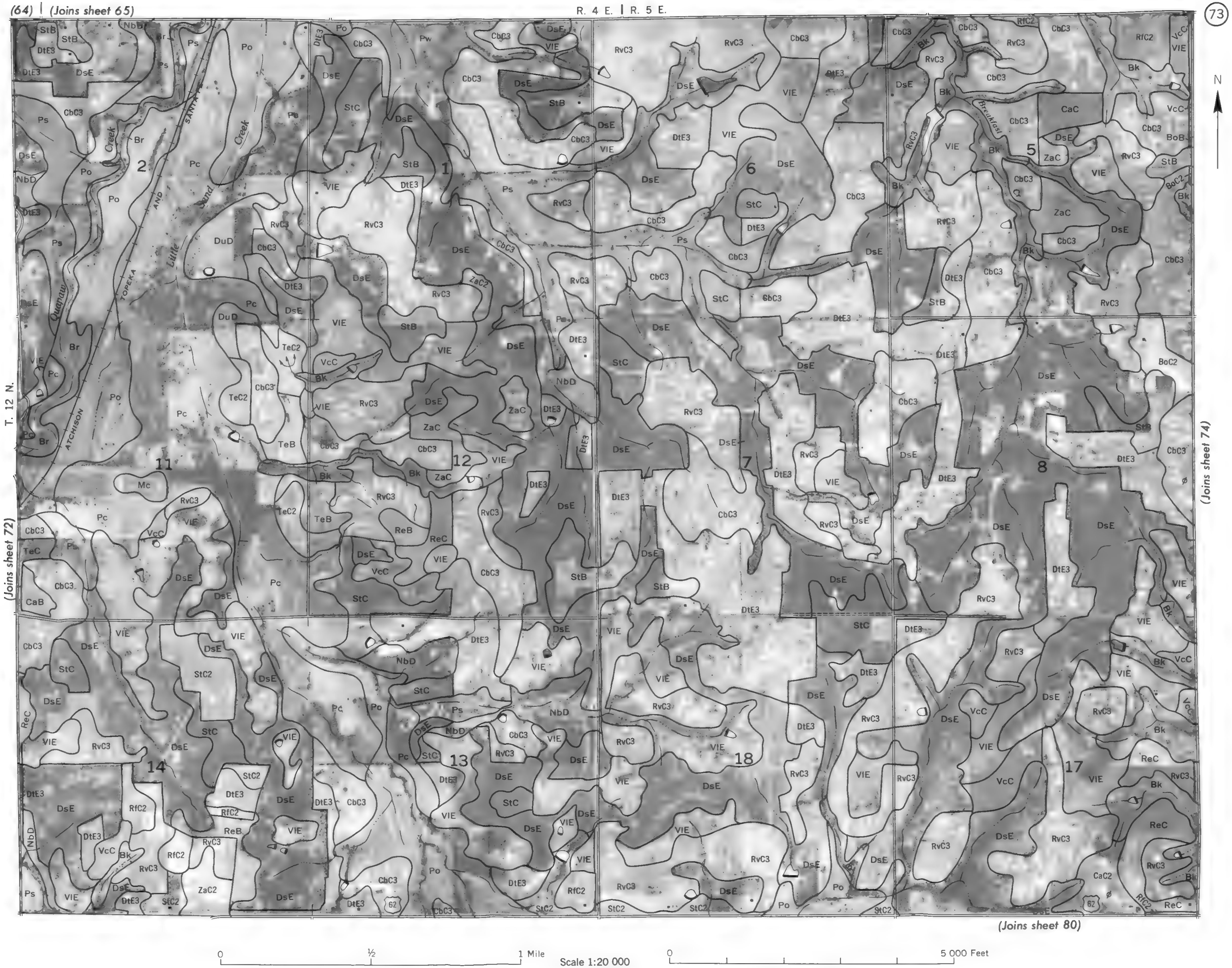


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 72

Land division corners are approximately positioned on this map.

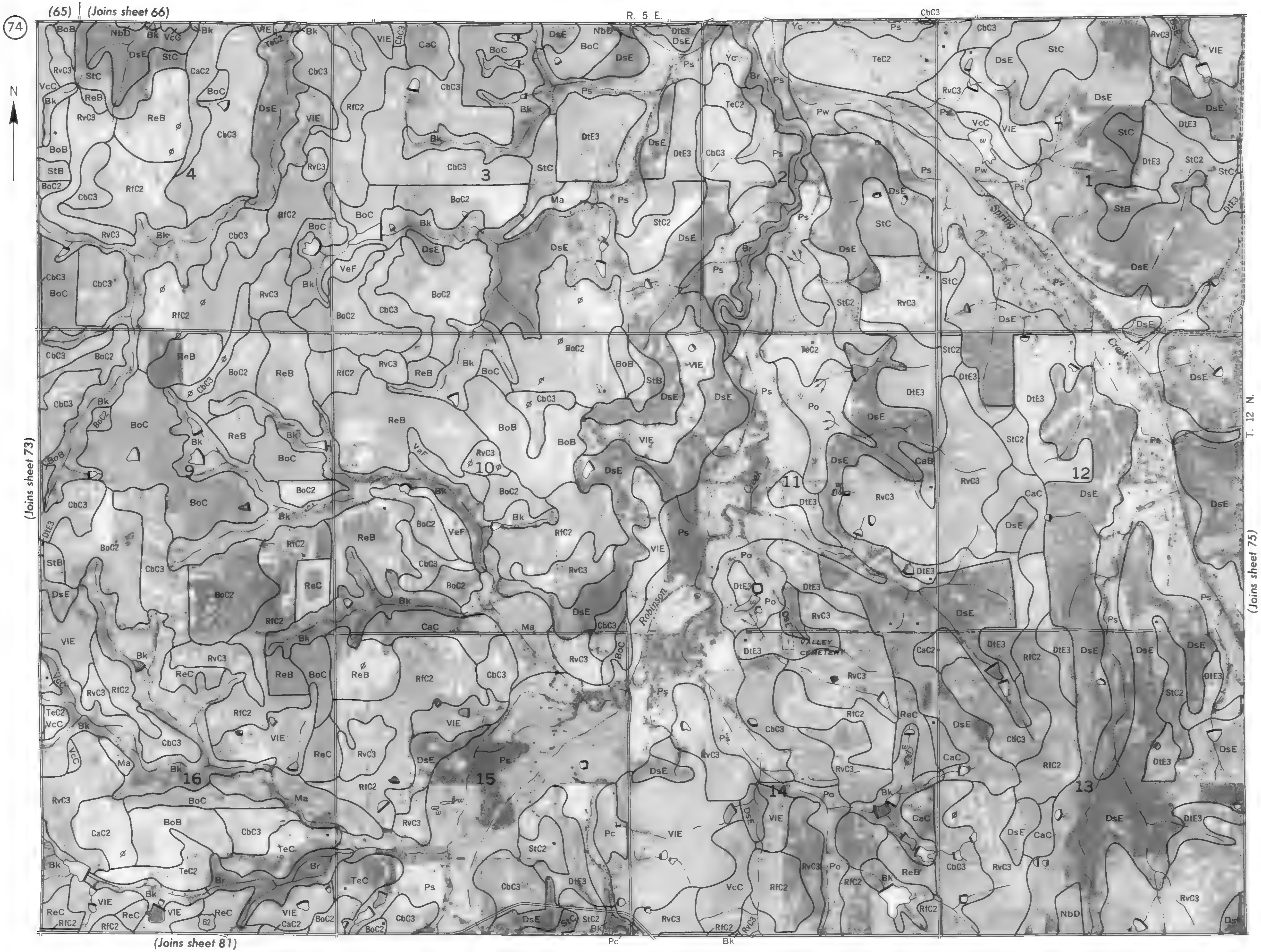
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

LINCOLN COUNTY, OKLAHOMA NO. 73

LINCOLN COUNTY, OKLAHOMA — SHEET NUMBER 74

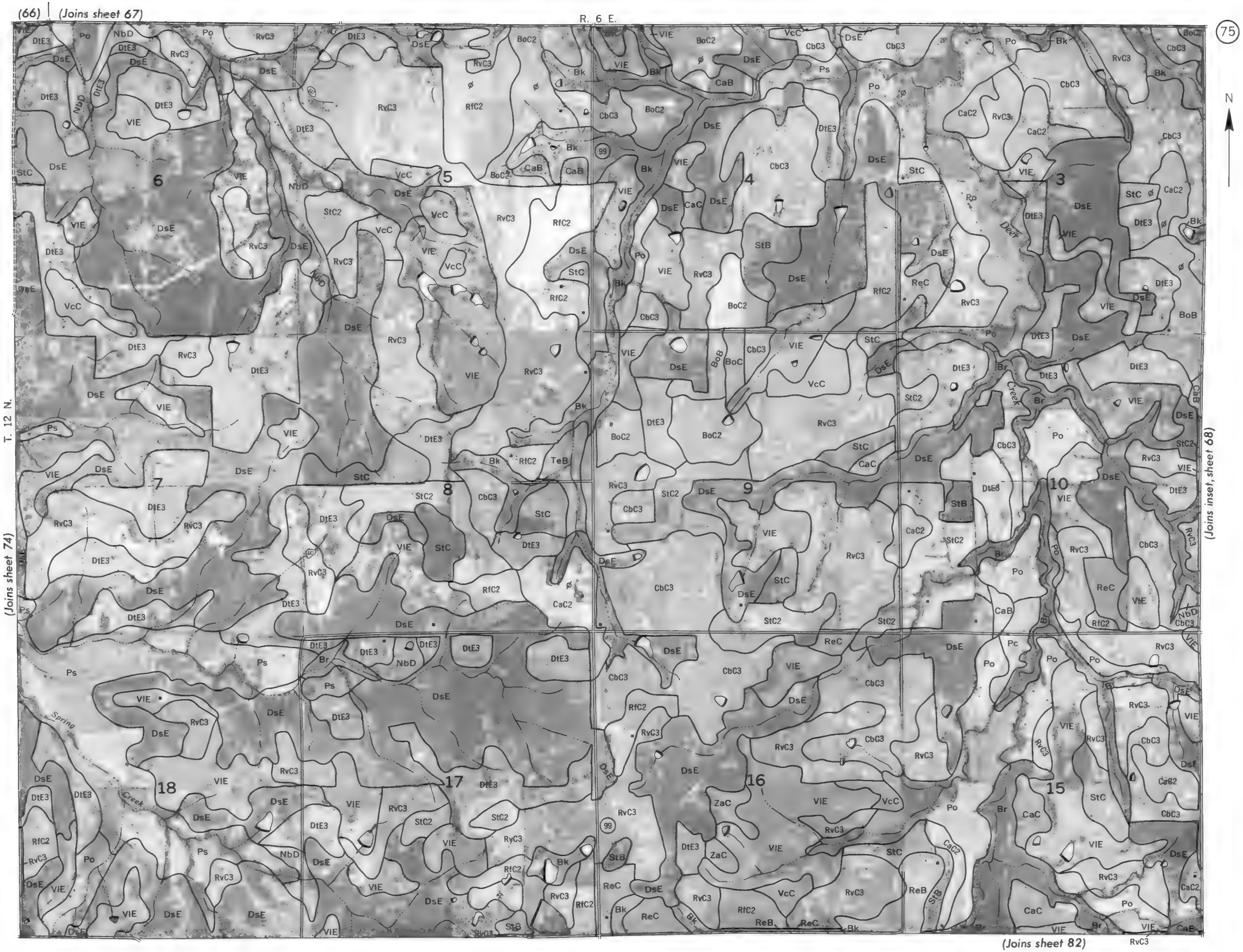


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 74

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

LINCOLN COUNTY, OKLAHOMA NO. 75

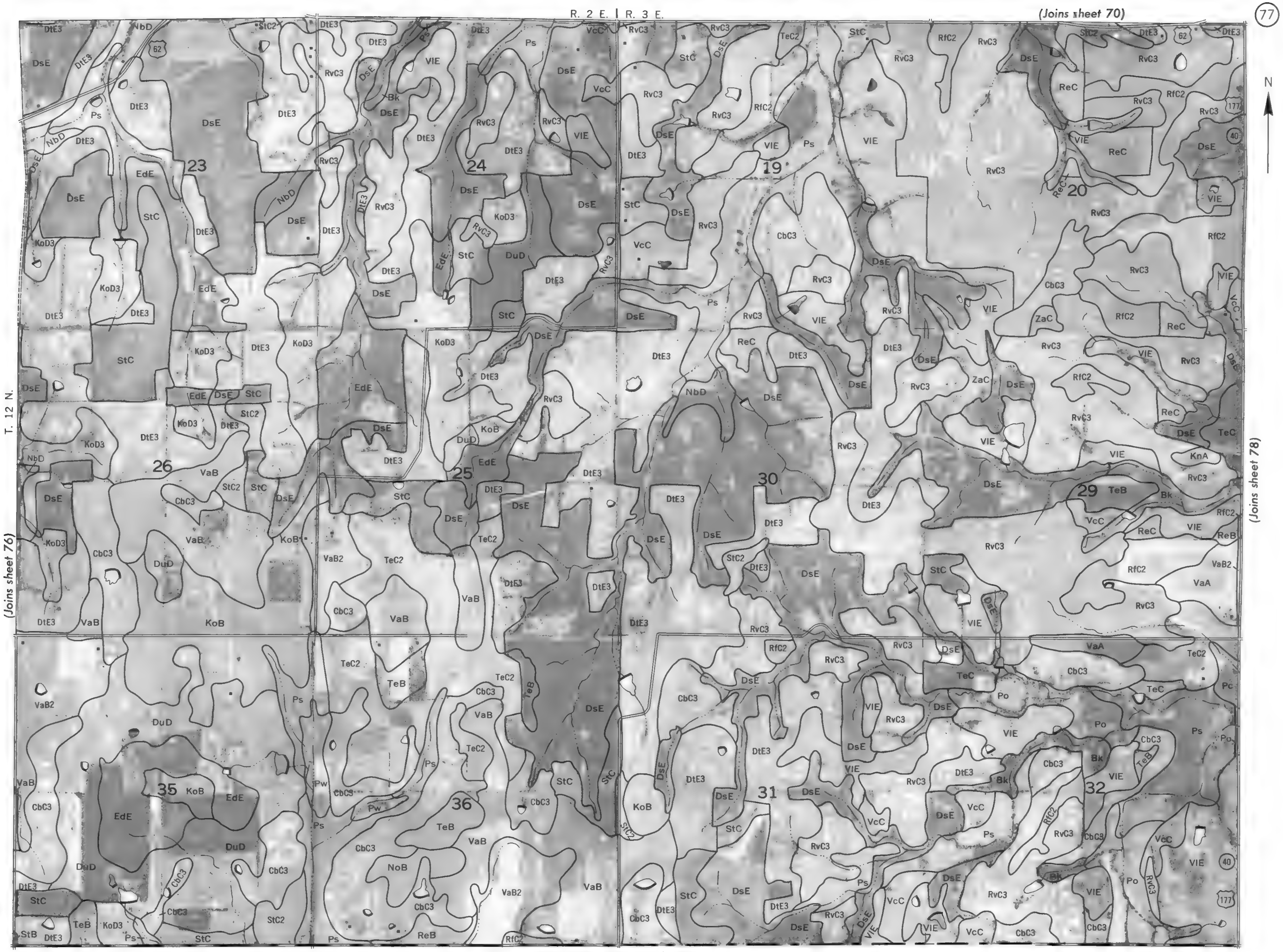
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 76

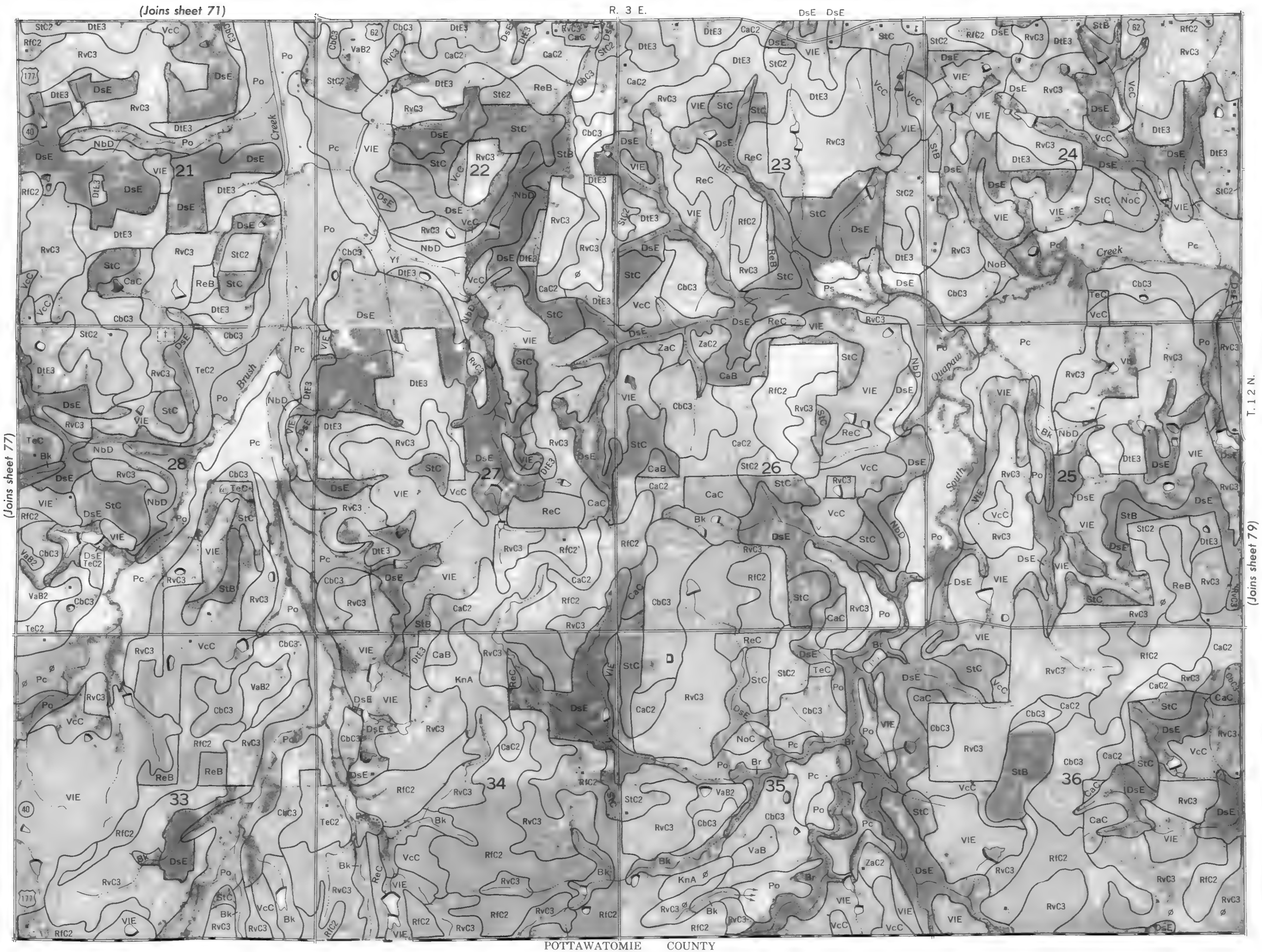
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

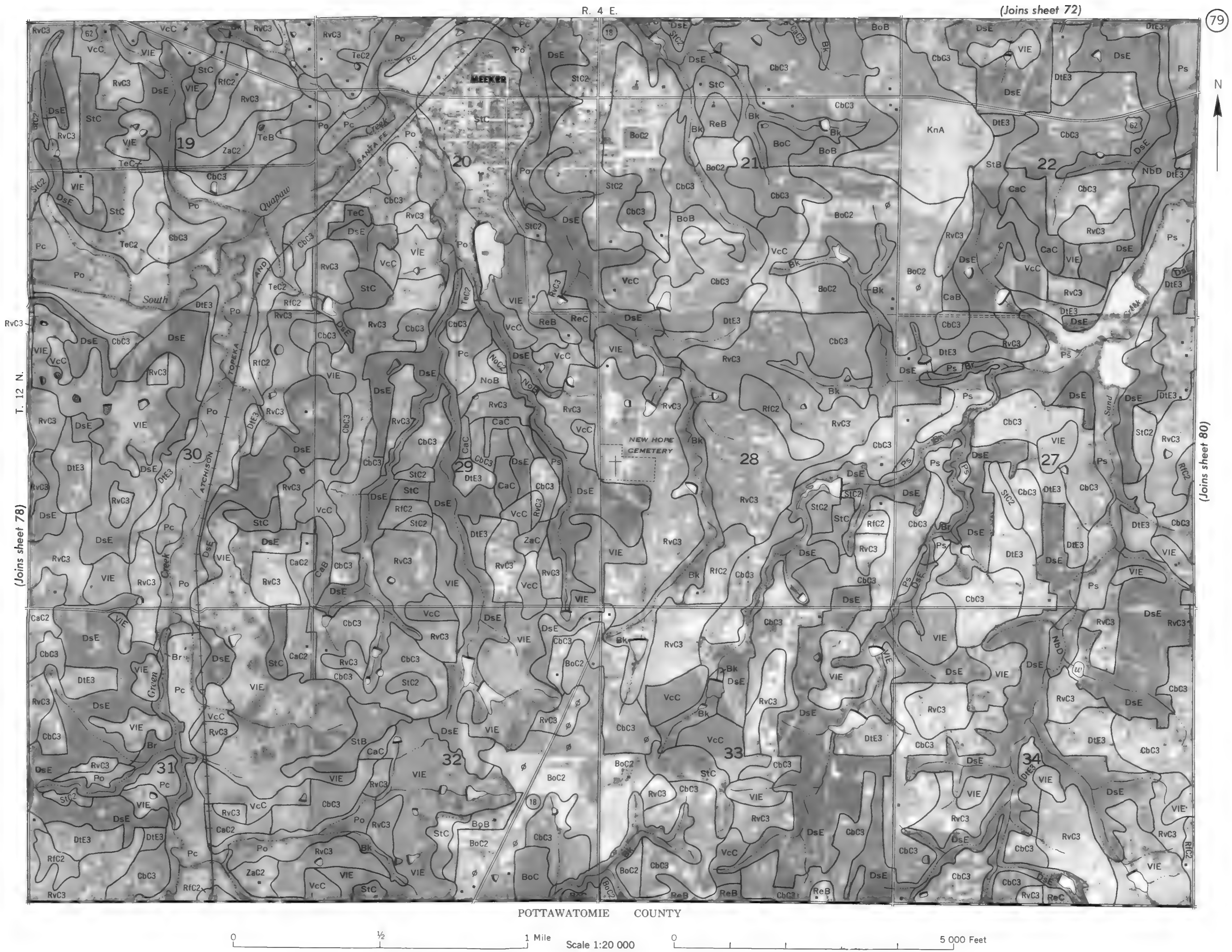


0 1/2 1 Mile Scale 1:20 000 0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 78

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.



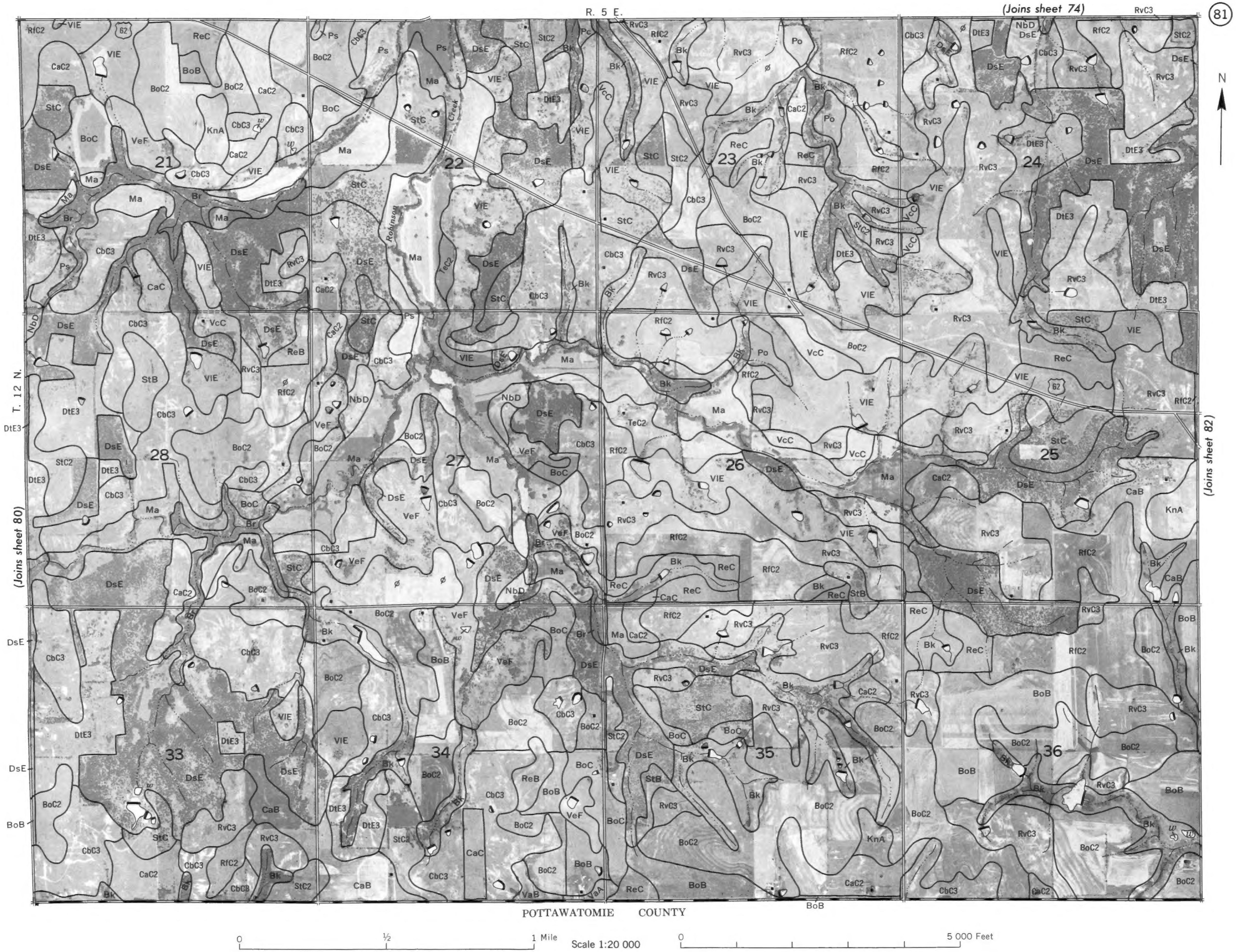
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

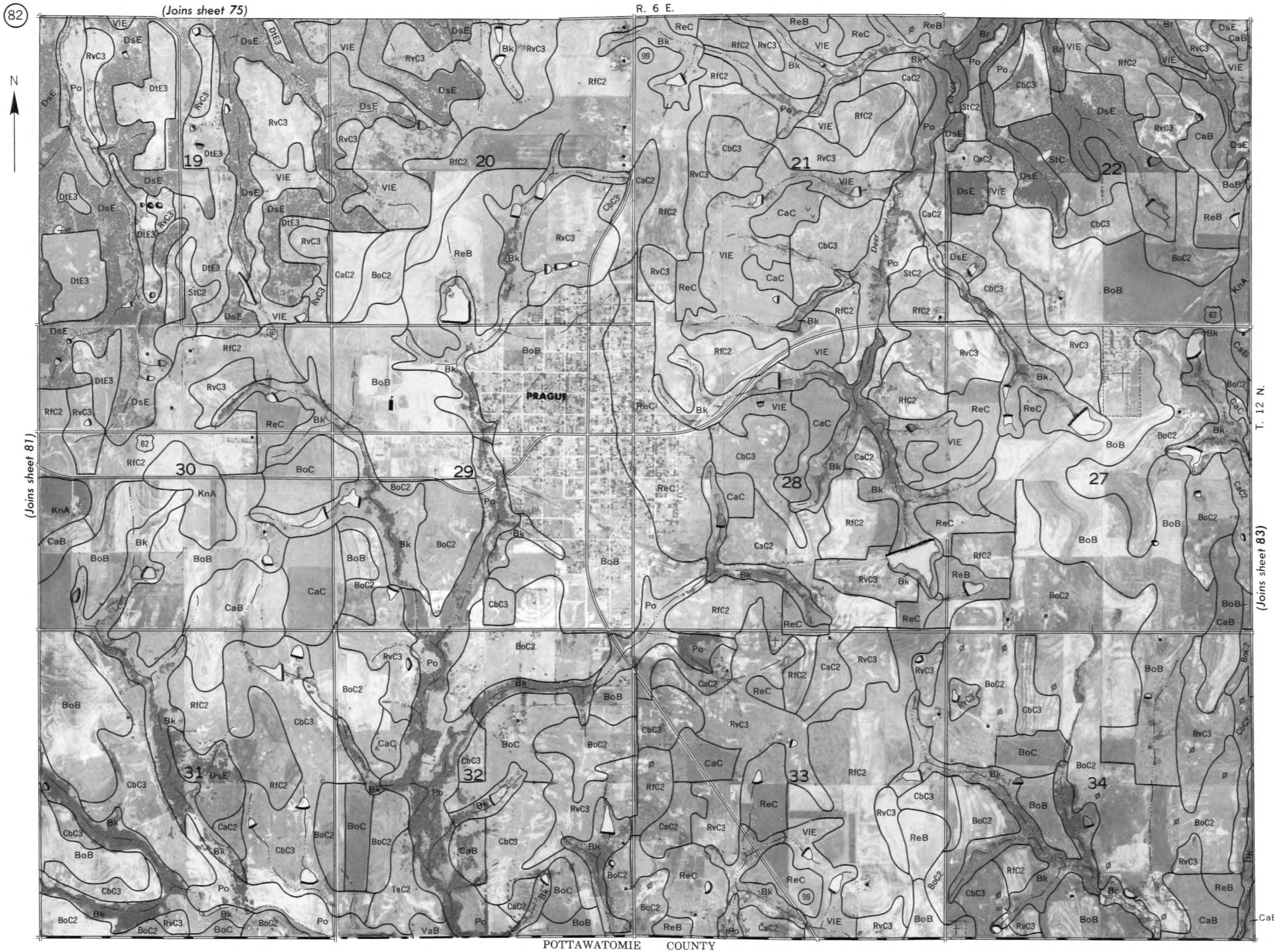
LINCOLN COUNTY, OKLAHOMA NO. 79

LINCOLN COUNTY, OKLAHOMA NO. 80

Land division corners are approximately positioned on this map.

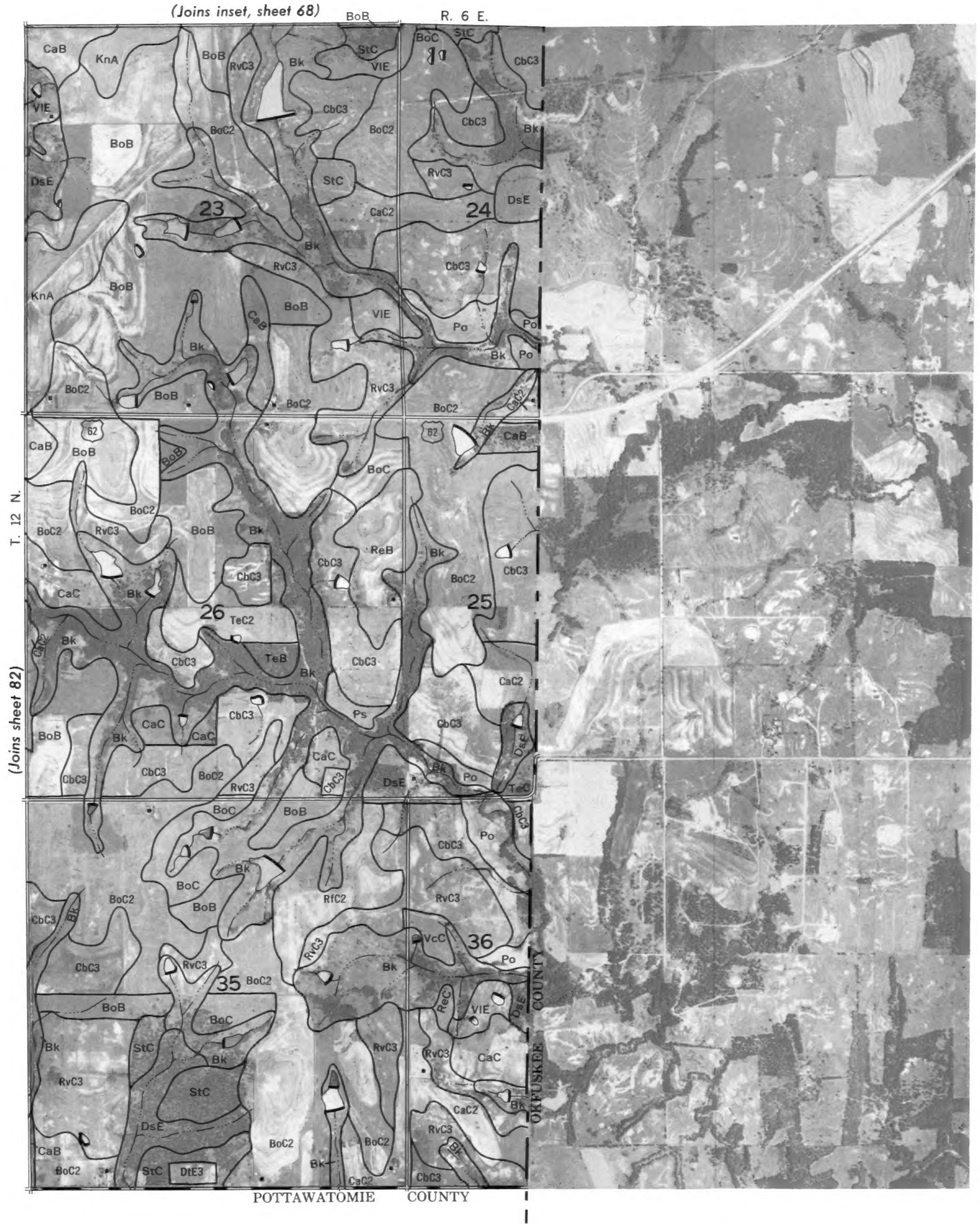
This map is one of a set compiled in 1968 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Oklahoma Agricultural Experiment Station.


R. 5 E.
(Joins sheet 74)
81
N
T. 12 N.
(Joins sheet 80)
(Joins sheet 82)
Robinson
Creek
21
22
23
24
25
26
27
28
33
34
35
36
POTTAWATOMIE COUNTY
0
½
1 Mile
Scale 1:20 000
0
5 000 Feet



0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

LINCOLN COUNTY, OKLAHOMA NO. 82



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet